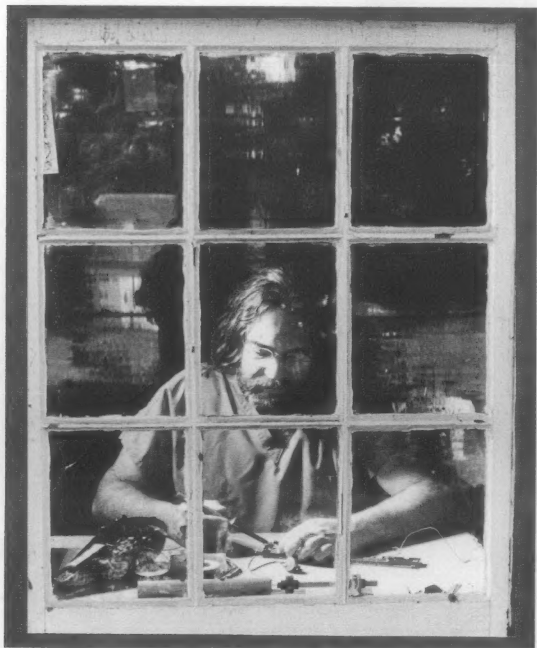


FOR THE DESIGN, CONSTRUCTION AND ENJOYMENT OF UNUSUAL SOUND SOURCES

EXPERIMENTAL MUSICAL INSTRUMENTS

YIKES!

Before it was an established fact that all electronic musical instruments must have piano keyboards, electronic instruments were conceived with a variety of player interfaces, and a corresponding diversity of gestural qualities. "Yes," I hear people saying, "like the theremin, with its mid-air playing technique." And, I add, like the ondes Martenot, with its unique ribbon or ring controller. In this issue you'll find Thomas Bloch's first-hand report on the ondes — less well-known than theremin, but still played today. And in a coming issue we'll have more on the theremin.



Above: Qubais Reed Ghazala engaged in circuit bending. See the article starting on page 23.

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Also in this issue you'll find a most-ly-pictorial review of Oliver DiCicco's Mobius Operandi instruments; a tutorial on spectrum analysis and available software; an essay on improvisation with experimental instruments; a report on scrap metal yard sound seeking; and a study of innovation and continuity in musical instrument forms across the African diaspora. In the photograph at left is a window to another approach to accessible, low cost, non-corporate and keyboard-free electronic sound exploration, described in an article by Qubais Reed Ghazala.

Welcome to this first issue of **Experimental Musical Instruments'** eighth year. Open now, and enjoy.

YES! EMI'S NEWEST CASSETTE WILL BE AVAILABLE THIS MONTH!

From the Pages of Experimental Musical Instruments Volume VII will be available at the end of August, and we are taking orders now. The cassette tape contains music from instruments featured in the six issues of EMI volume VII, from June 1991 through June 1992. A panoply of different instrument types appear, including:

Alec Bernstein and Daniel Carney's computer-controlled, electromechanically-played piano and percussion instruments;
 Qubais Reed Ghazala's circuit bending instruments;
 Peter Whitehead's available-materials instruments;
 Ferdinand Försch's metal tongue drums, strings and other instruments;
 Paul Panhuysen and Johan Goedhart's long string installations;
 Hal Rammel's Devil's Fiddle;
 John Hajeski's Portable Anarchy;
 William Louis Soerensen's environmental sound installations
 American and Indonesian membrane reeds;
 The Till Family Rock Band's lithophones
 Richard Waters' Waterharp;
 Leif Brush's Terrain Instruments;
 ... and possibly two or three more makers and instruments, not yet confirmed at the time of this writing.

— All good stuff!

The Volume VII tape, along with the previous volumes I through VI, are available to EMI subscribers for U.S. \$8 apiece, and to non-subscribers for \$11. Checks should be made out to Experimental Musical Instruments, PO Box 784, Nicasio CA 94946, USA

EMI's NEW QUARTERLY PUBLICATION SCHEDULE and new prices have taken effect. Notice that this, the first issue published under the new schedule, is a lot fatter than the previous issues.

NEW SOUNDS IN NEW SHAPES, under the direction of Carol Merrill-Mirsky, curator, is showing at the Hollywood Bowl Museum through April 1993. It is an exhibit of contemporary musical instruments from makers living and working in Southern California, including Bob Bates, Ivor Darreg, William Eaton, Jonathan Glasier, Jay Scott Hacklemon, Nobuho Nagasawa, Brian Ransom, Susan Rawcliffe, Bill Wesley and Ervin Wilson. Also on display are Harry Partch's Quadrangularis Reversum and Eucal Blossom. The exhibit includes a number of hands-on displays and audience-activated audio demonstrations. Live events associated with the exhibit are scheduled for Saturdays in August, 1:00 pm:

August 8: "Microtones and Polyhedrons", a lecture/demonstration on new scales and new instruments by Erv Wilson, John Gibbon and others.

August 15: "Music in the Cracks", comparisons of microtonal practices in Western and non-Western music, with Nabil Azzam, Dai Lien Vo and Erv Wilson.

August 22: "Megalyra Music", a demonstration of instruments made by Ivor Darreg, with Ivor Darreg and Jonathan Glasier.

August 29: "Clay Sounds", a performance by Susan Rawcliffe and Brian Ransom & The Ceramic Ensemble.

The Hollywood Bowl Museum is located on the grounds of the Hollywood Bowl at 2301 North Highland Ave., Los Angeles, CA 90078. For information call 213/850-2058.

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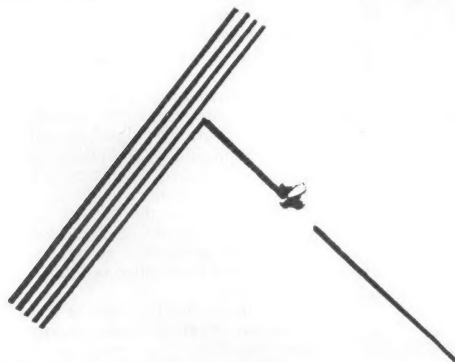
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"The Broken Staff in Felt" by William Louis Soerensen

MOBIUS OPERANDI

Instruments by Oliver Di Cicco

By Peter Whitehead

Oliver Di Cicco is an award-winning sound engineer; the owner and operator of San Francisco based Mobius Recording Studio. He's also an instrument builder. His work with instruments has been an attempt to step away from conventional instrumentation and present the player with an unfamiliar sound-source to which few of the parameters of more familiar instrumentation apply. For this reason, the player must take a fresh approach to playing technique, exploring unfamiliar territory. The limits of what works as "music" or "sound" composition or as simply "noise" can then be reconsidered, hopefully, to produce original music, appropriate to both the instruments and the players, free of historical associations and limits often imposed by conventional instruments. The nature of their construction demands a hands-on, tactile approach which Oliver sees as an antidote to the detached world of synthesizers, MIDI, and sampling. To produce a sound you have to physically interact with the instrument as an object. Often described as "sound sculptures", they are constructed mostly from recycled steel, aluminum and wood.

Oliver's group "Mobius Operandi", an ensemble of six Bay Area musicians, appears regularly in concert with the instruments, along with several smaller hand-held instruments made by other members of the group. Playing technique is

completely open; group members use a variety of mallets, bows, picks, brushes, slides, or their hands, depending on the sound they are aiming for. In addition, four members sing. The results range from free improvisation, experimental soundscapes and group compositions, to country western and psychedelic pop, a combination referred to in one performance as "post-industrial" folk. The sounds of the instruments are difficult to characterize, since they depend greatly on playing method (e.g. bow, soft mallet, hard mallet, scraping, damping etc.). Its usually difficult for an audience to pick out which instrument is making a specific sound when six people are playing together. Even the group members themselves often do not know.

THE INSTRUMENTS

The Bass (Figure 1 below), the first born, is a seventy-seven inch long zither with four strings and nineteen movable frets, tuned in fourths starting with D below the normal bass' low E. Each string has a magnetic coil pickup, and the triangular plate is amplified by a piezo contact pickup. A volume pedal is also used.

Abdul (Figure 2, overleaf) is a seventy-two inch tall circular instrument with two bridges, tuned counterclockwise in a cycle of fifths. A coil pick-up is placed toward the bottom end of every string and a volume pedal is used.

The Kalimba (Figure 3, overleaf) is based on the design of the African instrument of the same name. It consists of two tiers of twelve phosphor-bronze bars mounted at one end, projecting over a thirty-six inch high steel barrel, with a cir-

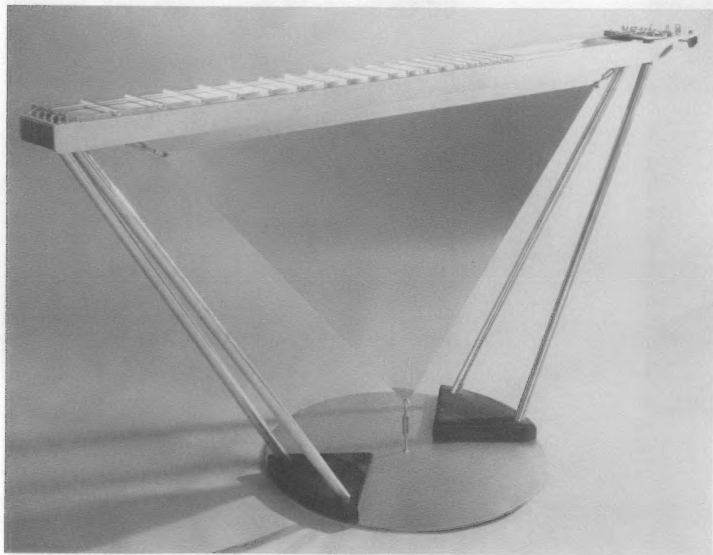
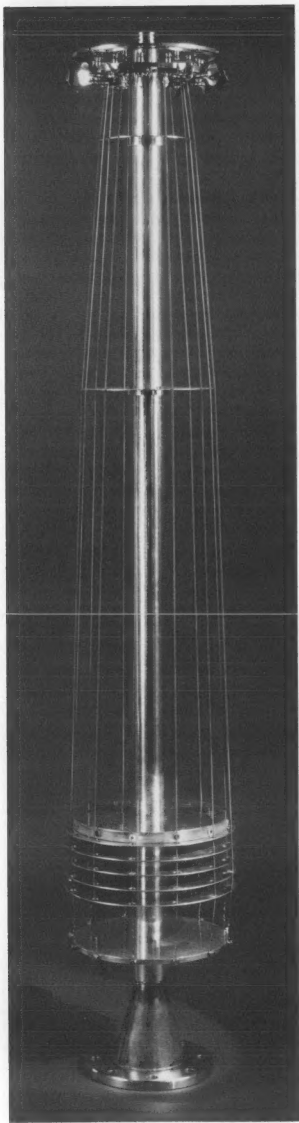


Figure 1
THE BASS

Photo by Oliver Di Cicco



cular hole at the center. This barrel acts as a resonating chamber. Each rod is amplified by a single piezo contact pickup mounted at its base. Tuning is chromatic, with the lowest pitch at the center and complementary whole tone scales ascending to the two sides.

The Trilon (Figure 4, facing page above) is a triangular zither standing fifty-five inches tall. Each of its eighteen strings is divided at its center by a brass rod and tuned chromatically starting at B flat on one side and F on the other. The three triangular metal plates are amplified by piezo contact pickups and the strings by magnetic coil pickups. A volume pedal is also used.

The Drone Drum (Figure 5, facing page lower left) is a forty inch tall, cylindrical, metal-headed drum with six strings running the length of its outside. The head is attached by screws and amplified by a contact pickup. The strings each have coil pickups and are tuned either to a chord or all the same note. A volume pedal is also used.

Eighteen Inch Drum, (still in progress) (Figure 6, facing page below right) consists of a tuneable drum head mounted over a steel cylinder. The cylinder tapers at its base to an eleven inch opening into which is fitted a circular metal plate. The plate acts as a valve, opening and closing the hole, thereby altering the flow of air escaping through the bottom of the cylinder and thus affecting the sound when the drum is hit. A second drum head is mounted on springs below this. This instrument uses a microphone, but is naturally quite loud.



Figure 2 (Above): ABDUL
Figure 3 (Left): THE KALIMBA

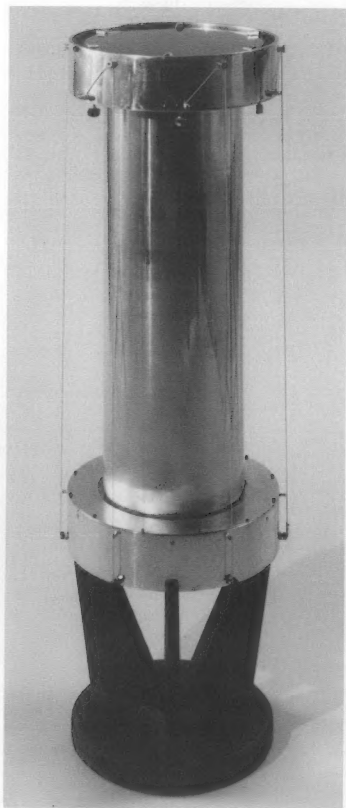
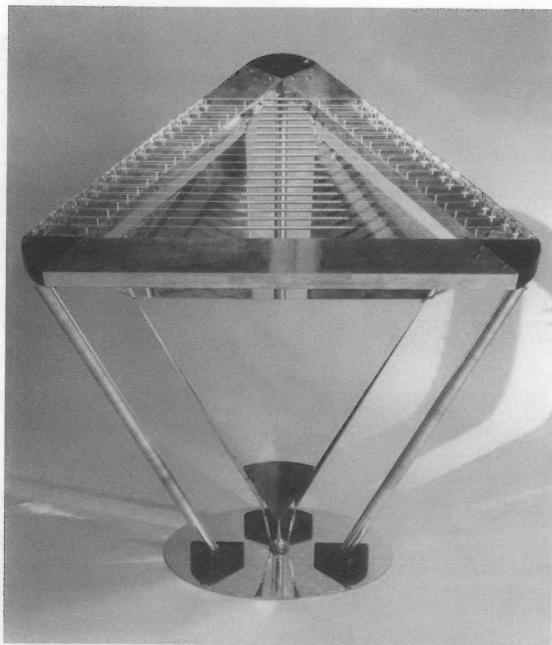
Photos by Oliver DiCicco

Figure 4 (right):
THE TRILON

Figure 5 (below left):
DRONE DRUM

Figure 6 (Below right):
18" DRUM

Photos by Oliver DiCicco



The Timbajo (Figure 7, below) consists of a set of four drum heads, sizes eighteen, sixteen, fourteen, and twelve inches, mounted over aluminum baking trays. Three wooden rods run across each drum head and come together in a circle of twelve one inch circular wooden pads at the center. Each rod is connected to the drum head by a wooden bridge and secured in place by two transverse metal rods. A series of twelve aluminum tubes of various lengths correspond vertically to the small wooden pads. The drum heads are fitted with contact pickups.

Due Capi (Figure 8, facing page), is a fifty inch tall double-headed wind instrument, fitted with two saxophone reed mouthpieces. The two mouthpieces are joined by a series of tubes and valves and are mounted on a metal cylinder into which the air passes and is amplified. When two people play simultaneously the flow of air from one mouthpiece affects the other and vice versa. This leads to interesting interaction and

effects. A third player can manipulate the valves to further affect the combinations of air blown from the two mouthpieces. This instrument is quite loud and usually requires no amplification. However, a microphone is sometimes used to balance it with the other instruments in performance.

The Percussion Tree (Figure 9, facing page) is a series of seven vertical steel rods mounted at their bases. They are shaped in various ways or support circular metal plates. Each rod is amplified at its base by a magnetic coil pickup system wound around the rod itself. The instrument stands sixty-one inches tall.

The pedals and magnetic coil pickups for the instruments are also built by Oliver. The volume pedals are phantom-powered, active direct boxes with volume control and effects loops.

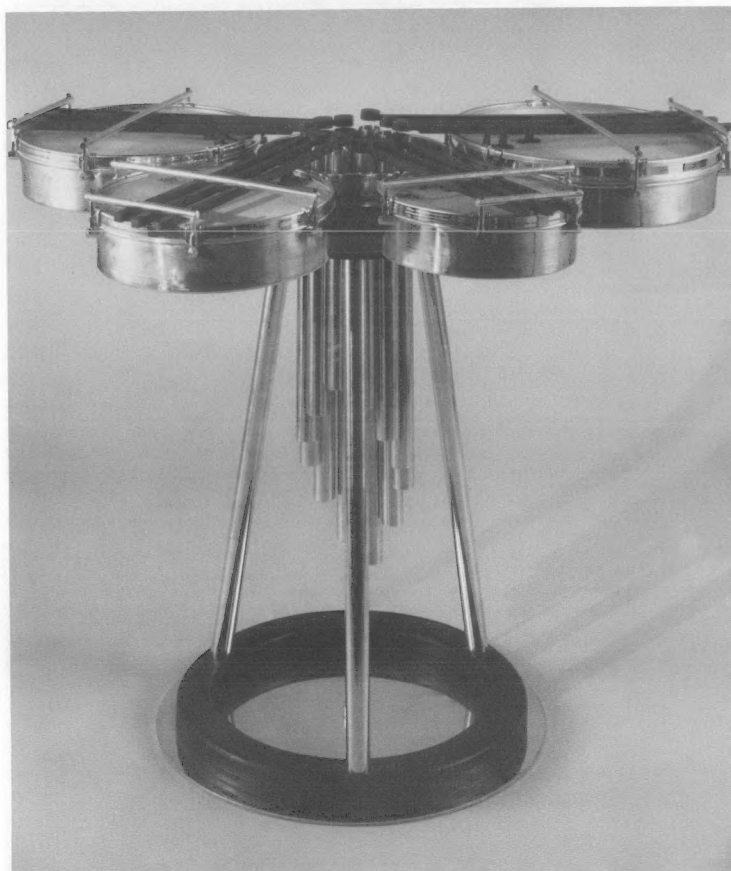


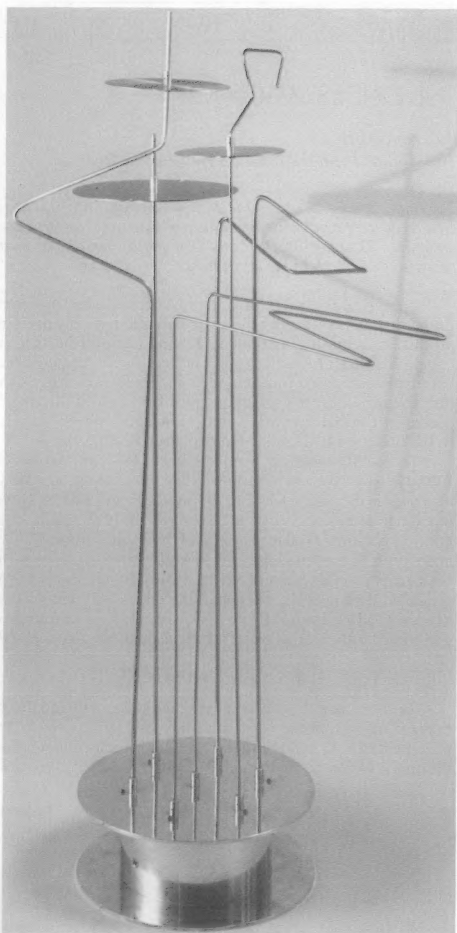
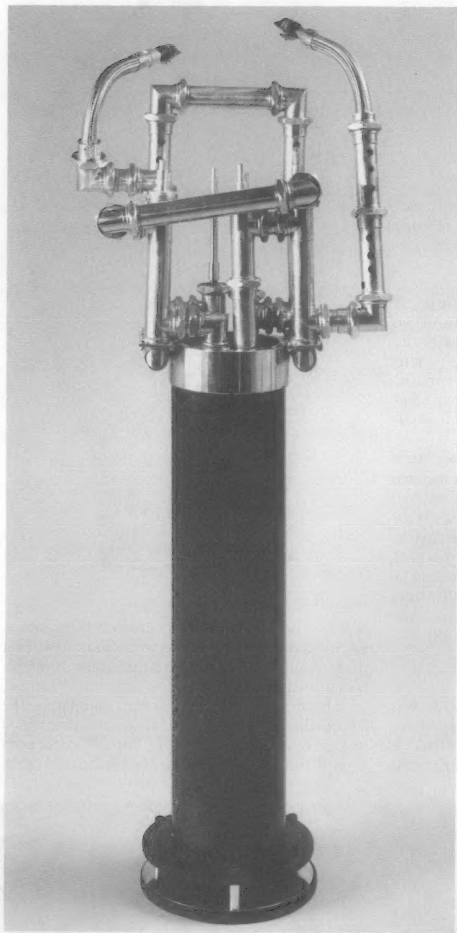
Figure 7 (left):
TIMBAJO

Figure 8 (facing page left):
DUO CAPI

Figure 9 (facing page right):
PERCUSSION TREE

Photos by Oliver DiCicco

Mobius Operandi, consisting of Agnes Charlesworth, Oliver Di Cicco, Miguel Frascóni, Jason Reinier, Peter Whitehead and Pamela Winfrey, performs frequently throughout the Bay Area. Information about the group and the instruments can be obtained from Mobius Music at 1583 Sanchez Street, San Francisco, CA. 94131. (415) 285-7888.



THE ONDES MARTENOT

By Thomas Bloch

Translated from the French by Sascha Reckert

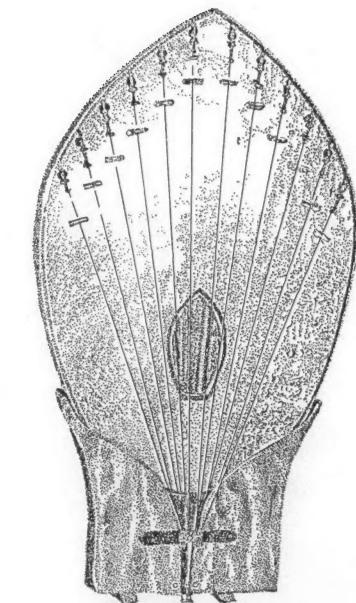
The ondes Martenot, one of the earliest electronic musical instruments, was created by the French inventor Maurice Martenot over 50 years ago. French composer Thomas Bloch, himself a performer on the instrument, has provided this report on the instrument.

Today twelve classes of ondes Martenot exist in conservatories in France and in Canada. But there are only about twenty performers and two professionals on this instrument: Jeanne Loriod (the sister-in-law of the composer Olivier Messiaen) and Thomas Bloch. About 1200 compositions have been composed for the ondes, including concertos, chamber music, film scores, songs (the singer Jacques Brel used it often). Famous composers for the ondes are Messiaen, Honegger, Jolivet, Varese. Additionally, the ondes is often used in symphonic orchestra.

Maurice Martenot was born in Paris in 1898 and died on October 8th in 1980. He gave concerts as a violoncellist from the age of nine years and was interested in the natural sciences. During the first world war, he was an engineer of radio transmissions, when he discovered (in 1917) that he could exploit the purity of vibrations produced by a set of three valves (tubes), while changing the intensity with a condenser. He built several instruments, and on May 3rd in 1928, presented the ondes Martenot to the public at the Paris opera. Afterwards, he presented it all over the world and the critics were enthusiastic: "If Mister Martenot had lived in the Middle Ages, he would have been accused of witchcraft and burned in the market place." (L. Schneider, New York Herald, 1928).

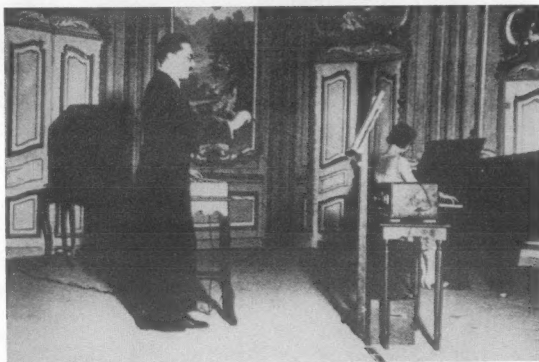
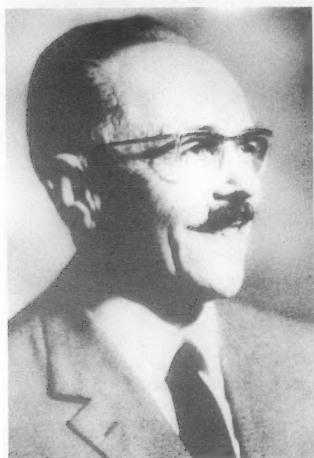
HISTORY OF THE ONDES MARTENOT

The instrument has been in existence since 1917 and the 8th model was realized in 1991. In the relation to this long period, few instruments have been built: less than 400. But it is still used today in many concerts and in the opera. In contrast to the ondes, most of the other electronic instruments



invented before synthesizers are nearly forgotten. Even today many composers write for it. 20-40 first performances every year are the result of the international interest.

The first instrument was very similar to the Theremin. The second model was the one which was presented in the opera of Paris. A cord, connected with a belt-pulley in a box placed on a table,



Left: Maurice Martenot

Above: Martenot presents the ondes in public for the first time (Paris Opera, 1928).

Facing page: Author Thomas Bloch with the ondes Martenot

allowed the player to change the frequency. Pulling the cord forwards and backwards produced different frequencies. A key was used for loudness and expression. The performer held the cord in his right hand while his left hand handled a key which looked like a piano key. The key had the same function as a bow on string instruments, but with more possibilities for control.

The third model was born in 1929. In addition to the features of the second one, it had markings like a keyboard, so it was easier to get the correct notes. With the help of Leopold Stockowski, the ondes began to tour around the world.

The fourth generation followed immediately. A real keyboard appeared. There are two different ways of playing on the instrument. One is with the cord and at the end of the cord a ring, which the performer puts on his or her index finger to play. The second is with the keyboard. Both exist still today, but with ameliorations: the keyboard is movable and can be displaced from the left to the right to vibrate (+/- 1/2 tone) to produce micro intervals. Concerning the cord, it was placed in front of and along the keyboard on the fifth model. But it was still on the fourth model that Martenot added a "metallic" loud-speaker to the usual loud-speaker called "principal." The metallic loudspeaker was a metal gong placed in front of the loud-speaker, which begins to vibrate. And in 1932, the Indian poet Rabindranath Tagore ordered from Martenot an ondes which was able to play 66 notes per octave, to play ragas.

The fifth model is from 1937. O. Messiaen composed a composition for six ondes which got the "Grand Prix de l'Exposition Universelle de Paris". The cord on this model was connected with a ring which the musician put on the index of his right hand. By placing the finger (and so the ring) in front of the keys of the keyboard, he obtained the corresponding note. It was now possible to realize glissandos over the complete range of the instrument (about nine octaves on the seventh model, and still more on the eighth model) by pressing the intensity key (left hand) all the time. To get other musical effects similar to usual techniques of a singer or violin player (staccato, portamento, etc.), the performer on the ondes has to release the intensity key for the breaks between the notes. The sounds and colors are numbered from 0 to 8 based on sine-waves. These switches for the sounds are placed near the intensity key, to be used by the left hand, in a little drawer.

With the sixth model appeared the loud-speaker called "palme" (because it has an outline like a duck-foot). In 1950, Martenot invented this loud-speaker, designed as a sound box with twelve tuned resonance strings on each side. The resonance strings produce an echo when this loud-speaker is used. Today the "palme" is replaced by a loud-speaker called "resonance", more effective and less fragile (springs instead of strings).

Judging by his own opinion, Martenot was completely satisfied with the seventh model, which appeared only in 1974. Now he used transistors instead of tubes. It also allows the player to produce micro-intervals as small as 1/64 of a tone.

The sounds are marked by letters (see the drawing). But through all the time, Martenot preserved his basic ideas: to build a musical instrument (and not a machine) which follows the intention of the performer.

SUMMARY OF PRINCIPLE TECHNIQUES AND SPECIFIC PERFORMING ASSUMPTIONS

The ondes is a monophonic instrument. The right hand plays the keyboard (especially for the virtuoso parts), or the cord (especially for lyric musical passages). On the cord (with the ring on the finger) the performer also makes glissandi and special effects, like vibrato (also possible on the keyboard), etc. With the cord, the gesture determines the sound result. The left hand controls the sounds and the intensity key.

The difficulty in playing the ondes starts with the combinations of all these techniques: to work out the vibratos, the quick changing timbres and sounds, the exact control of loudness (with the intensity key) and pitch, the virtuosity, musical expression and respiration — all these techniques together need several years of study. Martenot himself wasn't that interested in sounds, but the ondes has more 10,000 possible mixtures.

In addition, for Martenot the ondes had a close relation to the possibility of high expression and breathing as a prerequisite for making music and playing the ondes well. Therefore he wrote a book about techniques for breathing and relaxation. What is also well-known in France is the "Method-Martenot". This method relates to painting, sculpture, dance, music, etc. and is mostly based on gesture.

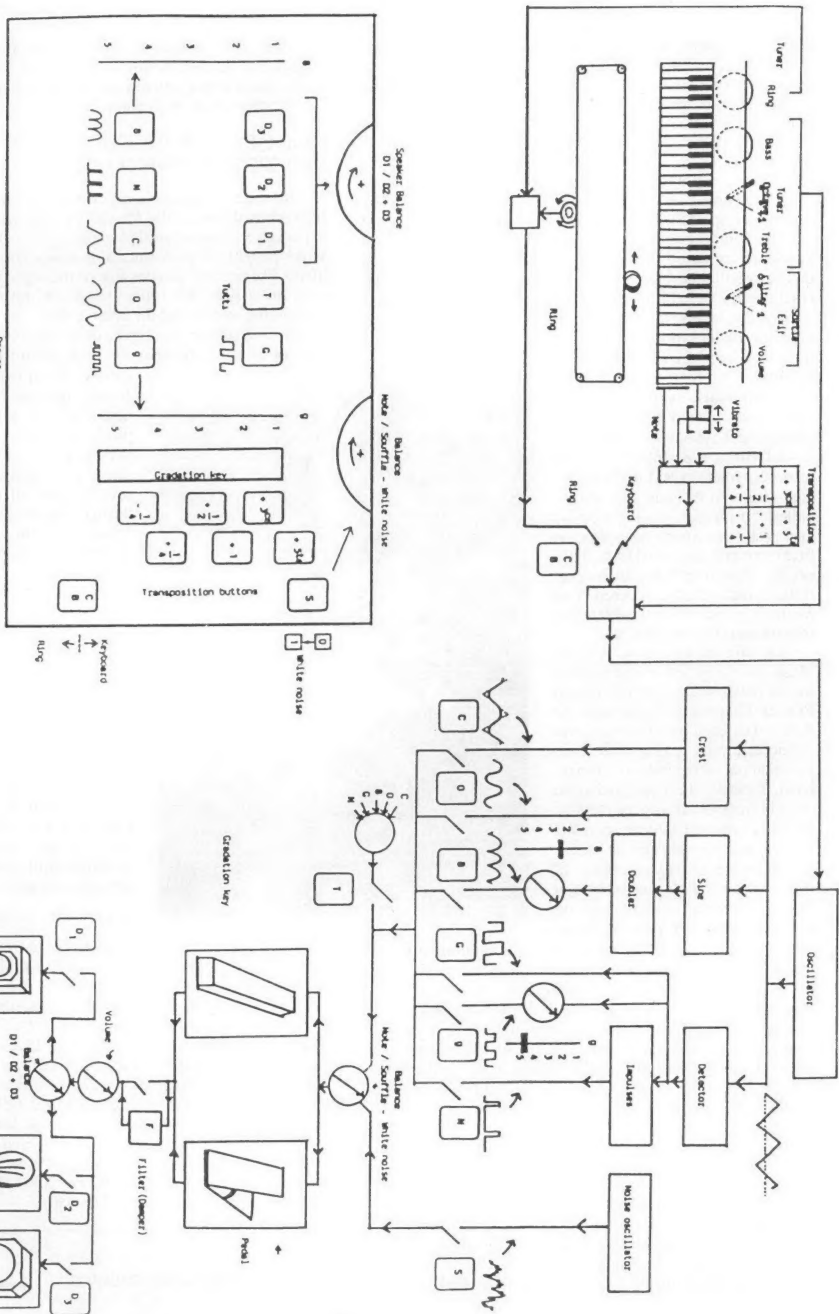
With this background the ondes was more than just an instrument for Martenot, it was an expression and a medium for an art-style and a life-style.



Thomas Bloch is a musician (ondes Martenot, glass-harmonica, cristal Baschet), composer and musical scientist. He gives more than 150 concerts every year as soloist, in the world. His compositions are also played all over the world. A CD with his instruments ("Christ Hall"/Thomas Bloch) is available in Europe (K.617, 15 rue du General De Gaulle, 57050 Le Ban St. Martin, France) and in the U.S.A. (G. Finkenbeiner, 33 Rumford Avenue- Waltham, Mass. 02154, USA; or: GMI, 2503 Logan Dr, Loveland, CO 80538, USA). It is possible to write to Thomas Bloch to get further information about the ondes Martenot Glass harmonica, Cristal Baschet (and concert requests): 9 rue de Castelnau, 68000 Colmar France; phone: (33) 89.41.26.79, Fax: (33) 89.41.18.23 (Free documentation with photos will be sent).

MORE PHOTOGRAPHS AND DIAGRAMS





GENERAL SCHEME FOR THE ONDES MARTENOT

The keyboard, ring, and related player controls are diagrammed in the upper left. At upper right are the timbral modifications, leading to the three types of speakers below right. At lower left are the timbral, speaker balance and transposition controls found in the drawer.



Above left: The control drawer for the left hand, with the intensity key (white) and timbre controls.



Above right: The copper contacts for the keys, and the keyboard vibrato system, below the keyboard.



Left: The ribbon system. Below can be seen the potentiometer that varies the frequency, and the finger ring is above right.

Right: The keyboard and the ribbon ring on the finger.



Below left: Rabindranath Tagore's instrument (1932), capable of microtones.

Below right: amplifier for the 1955 model, with the controls drawer below right.

MORE PHOTOS →





Editor's Report

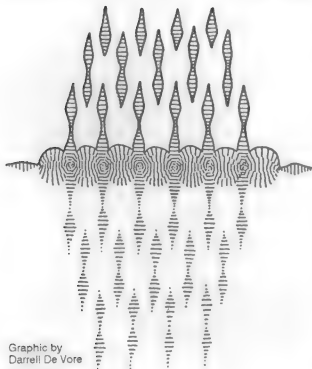
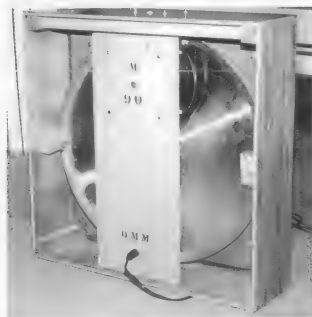
BUT SERIOUSLY, FOLKS

by Bart Hopkin



Above: The Palm

Below: The metallic speaker, seen from the back.



Graphic by
Darrell De Vore

With this issue **Experimental Musical Instruments** begins its eighth year of publication. Each year, in the first issue of the new volume, I report on how we are getting along. So here it is — my annual report.

EMI remains the only periodical devoted to the broad range of interesting and unusual acoustic and electroacoustic musical instruments. We have staked out as our territory the great diversity of possible approaches to the instruments of musical sound, with an emphasis on all that is unusual and inventive. This focus remains unchanged since EMI's first number appeared forty-two issues ago.

Starting with this issue, EMI is converting to a less frequent publication schedule (fewer issues per year) and a longer format (more pages per issue). The plan for the new quarterly format is not only to include more articles and more substance in the longer issues, but also to be more generous with space, creating a roomier layout and allowing larger photographs and graphics.

As in the past, I will take the opportunity of this yearly editorial to remind readers of ways in which they can have input into EMI. EMI thrives upon contributions and comments from its community. Letters to the editor are always welcome, and are a good way to communicate with the readership as a whole. We also welcome suggestions for article topics, publications or recordings for review, and the like. Remember that subscribers can place ads or other blurbs in the notices column, up to forty words free of charge (write for complete advertising information). And we are always interested in article submissions. Many of our best pieces come from readers who see in EMI an opportunity to share some valuable knowledge or ideas they possess. Call or write for an information sheet on writing for EMI, and be sure to check in, by phone or letter, before undertaking a substantial writing project with EMI in mind.

Finally, I would like to publicly thank the many people who contribute to the making of EMI. Let me start with some who have recently been writing for us on a regular basis. Mike Hovancsek has come on board to do our recordings reviews as well as bringing excellent articles on avant-garde and underground musicians and builders. David Courtney has consistently come up with valuable and timely suggestions for article topics, and followed through with lucid, highly informative articles (including this issue's report on spectrum analysis software). Robin Goodfellow continues to provide many of our most beautiful graphics, as well as making innumerable behind-the-scenes contributions grounded in her knowledge and love of musical instruments of every sort. We can be grateful that two authors with articles appearing in this issue will be contributing on a regular basis in the future: they are San Francisco sound sculptor Peter Whitehead, who will be researching and writing on a wide range of topics, and electronics explorer Qubais Reed Ghazala from Cleveland, who will focus on creative manipulation of electronic circuitry.

And although they've heard me express my appreciation many times before, I'd like say thanks and call attention once again to the contributions of a few more of the usual suspects: Hal Rammel, Darrell De Vore, Richard Graham, Tom Nunn, Donald Hall, Richard Waters, Ivor Darreg, François Baschet, all have given much, and given much again. In addition to these and others who have made multiple contributions, there's an ongoing list of worthy people whose work has found its way into these pages at least once. Allow me to add here the names of Jeannie Filson and more recently Cathy Chaney, who have held things together in EMI's office, and Janet Gillies, our proofreader and bookkeeper. Finally, there are the people at Barlow Printing in Petaluma, CA who print each issue, and Ace Printing and Mailing in San Rafael who get each issue out to you. To all these people, EMI says **thanks**.

Welcome to EMI's year number eight. We're still in the thick of things.



IMPROVISATION WITH EXPERIMENTAL MUSICAL INSTRUMENTS

by Tom Nunn

Before beginning, I would point out that what I say in this article may be obvious to many, but I thought this subject should at least be broached in the pages of a journal such as this. And I would hope this article might stimulate other designers/builders to take improvisation seriously as a way of utilizing the full potential of their instruments.

Perhaps two of the most rapidly developing areas in music today are improvisation and the creation of experimental musical instruments. Obviously, **Experimental Musical Instruments** is the main source of information about the latter. And the once-a-year publication **The Improvisor**, published in Birmingham, Alabama, is likely one of the best chroniclers of the improvisation movement today, containing articles written by various improvisors from all over the country and abroad. Publications about both subjects abound in the form of books and articles, as well as a plethora of music in the form of CDs and tapes.

My practice of building and performing with instruments of my own design is essentially evenly divided between these two areas, since my instruments are made specifically for improvisation. I believe the practice of improvisation and that of building experimental musical instruments are a perfect match. Improvisation is a real-time exploration of musical possibilities, for the audience as well as the performer. Experimental musical instruments, with their unique sounds and performance techniques, provide a fertile ground for exploration in performance without the "baggage" traditional instruments bring with them. This "baggage" amounts to the expectations of the audience and performer within the context of the instrument's own tradition — its literature or common uses and associated styles, its master performers, its accessibility to learning and general degree of widespread use, etc. Experimental musical instruments, in a sense, wipe the slate clean when it comes to audience expectations, presenting the listener with delightfully new sounds and demanding a more open mind with which to perceive them musically.

Another consideration, one which distinguishes EMIs from traditional instruments, is the lack of musical literature. Obviously, a recently invented instrument has no literature (unless it is some adaptation of a traditional instrument with literature). So, there are two (not mutually exclusive) solutions: to write music for it, or to improvise with it. Each approach has its advantages and disadvantages. However, improvisation offers an opportunity to become immediately and intimately aware of the music the instrument wants to make. And, of course, even if intending to compose for it, improvisation often plays a vital role in the process of composition.

Therefore, in this article I would like to discuss the relationship of experimental musical instruments to the art of musical improvisation in terms of how each supports and enhances the efforts of the other.

PHYSICAL AND ACOUSTICAL LIMITATIONS OF THE INSTRUMENT

No single instrument can do everything. That goes without saying, but I said it anyway, because I sometimes find myself trying to come up with such an instrument! (Perhaps other EMI designers have the same fantasy.) Every instrument has its limitations..., and yet, improvisation is, by definition, something unlimited. We might think of this situation as an infinite field of probabilities (improvisation) within a finite field of possibilities (the instrument). However, we might also think of it as one kind of exploration within another, that is, a real-time exploration of the *instrument* within a real-time exploration of the *musical imagination*. But the nature of both areas of exploration are dependent upon *experience* — let's call it "relative familiarity" (relative to musical self-perception and the musical perception of others). This experience, or relative familiarity, bears directly on both the process of simply playing the instrument (performance technique) and the process of improvising (real-time composition). Great familiarity with the instrument assumes a highly developed performance technique such that the player need not think about how to play the instrument; it is second nature. Great familiarity with the art of improvisation assumes years of experience improvising in all sorts of situations and contexts. (One might even say that the "technique" of improvisation is experience, implying a long-term subconscious, as well as conscious, development of real-time musical awareness.)

On the other hand, little familiarity with an instrument (traditional or not) implies a need, on the part of the player, to concentrate on the demands of playing the instrument; it is a highly conscious process in which sounds are discovered (or rediscovered), and thus have a certain special power by virtue of their distinctive nature. Little familiarity with improvisation implies little or no experience improvising. This is not to say, however, that the improvisations of beginners need be uninteresting. It is simply important to work within (and to the edge of — something I'll talk about later) one's capabilities. Although in one sense improvisation is the most difficult form of music-making, it is also the most accessible. In this context, the practice of Zen has much to tell us: *Zen mind, Beginner's mind*. We might interpret this, in improvisation, as casting off the baggage, opening up to what is inside one's own mind, in the moment. This is the essence of creativity. But to get to this point, conscious distractions, which make us self-conscious, must be eliminated. Our full attention, as improvisors, (so-called "beginners" or not) must be directed to the musical moment.

Difficulty can be found in that middle ground, where the improvisor gains a dangerous amount of knowledge and becomes more involved in technical facility than in music. It has been my experience that when I've made a new instrument, it is pretty easy to improvise interestingly on it. The freshness of the new sounds (or new arrangements of sound devices) offers

many new ideas and promises unlimited potential. However, as I become more familiar with the instrument, that freshness wears off. The improvisations can become less interesting, more technically oriented (as I develop new techniques) and self-indulgent (i.e., more interesting to the player than the audience); less *beginner's mind*. As this continues, a challenge (I characterize it "the wall") presents itself: the challenge to go beyond what can already be done and to discover deeper, musical implications. You could say that the challenge is always there; true. However, it's more apparent at some stages than others. The "wall" has to be broken through. When that happens, a new plateau of technical facility, of freshness of ideas and of new potentialities is reached, and the process begins again, cyclically, toward the next plateau, a process that never ends.

RELATIONSHIP OF IMPROVISOR TO INSTRUMENT

In the case of experimental musical instruments where the maker is often the player/improvisor, he/she is likely the world's most proficient player of that instrument because of its one-of-a-kind nature. But does that make him/her a master? Certainly not. It only represents a relative familiarity, even though the greatest on earth! As such, this proficiency includes both past experience and future potentiality (representing the ongoing reflective/projective nature of the process). The challenge to the EMI improviser is to constantly explore and express meaning in what is there, inherent in the instrument itself, under the musical circumstances of the moment.

Approaching an experimental musical instrument as a player, how does one (or how should one) go about learning it? If one learns the instrument with some step-by-step methodology, one learns only how the instrument functions, period. However, if the approach is through improvisation, the player will not only learn the function of the instrument, but come to understand its musical potential as well. The very technique of playing the instrument will be inseparable from the music it wants to play.

This brings up an idea I feel is important about the relationship of the improviser to the instrument, regardless of circumstances, but particularly in the case of improvising with experimental musical instruments: **The instrument plays the player as much as the player plays the instrument.** It is, in a sense, a dialogue wherein suggestions are presented and responded to, by both parties! The instrument strongly impacts the music, which takes on its own life through improvisation, making demands that may run counter to the improviser's momentary physical impulse, in which case the improviser must listen and follow through according to the musical dictates of the moment.¹ Then at some point, the music demands the improviser make a suggestion (i.e., take it in a new direction). This back-and-forth interaction should be ever-present in improvisation. When it is not, it is obvious; either the music wanders from one undeveloped idea to the next or we just get a show of pyrotechnics with about as much musical meaning as any acrobatic act! That's why I consider the instrument as playing the musician as much as the reverse.

RELATIVE FAMILIARITY OF FELLOW IMPROVISORS WITH EMI IMPROVISOR

All improvisors are listeners. This we may consider axiomatic. Of course, they are, at the same time, performers and composers. As listeners, fellow musicians in a group will be influenced by the new addition of an EMI in the group. At

first, the EMI can bring out new material, even from the other players on their own instruments. It is a new voice requiring new relationships to the other instruments. However, if there is not enough sensitivity to the new instrument in the group, it can ultimately be isolated, outcast, or forced to take on the role of another, traditional instrument. The personality of the EMI is usually complex and makes close listening demands in order to fully realize its potential. Without this sensitivity, there is not only no place for the EMI in the ensemble, but there is no place for the serious improvisor either, because it's a closed system.

I am currently playing with three different quartets, ROTODOTI (with trombone/voice, cello, and computer), Strich (with cello, trumpet/synthesizer, and drum set), and C-SIDE (all EMI band with Bart Hopkin, Richard Waters and Darrell DeVore). Each group has its own character, its own personality, its own sound world. Apart from the obvious concern with dynamic balance among the instruments, there seems to be no problem integrating my sounds and musical tendencies with those of the other instruments and players, whether or not I'm the only EMI improvisor in the group.

Suffice it to say, EMIs can work very well with traditional instruments in improvisation, given the necessary sensitivity and musical perception of the improvisors.

RELATIVE FAMILIARITY OF THE AUDIENCE

In improvisation, the improvisor is the chief member of the audience — the listener who controls. But for our purposes here, I distinguish the audience as the listeners who are not in control (though the audience often does have some influence over improvisations). Assuming the audience has never heard the instrument before, a tendency is to relate the sound to that of something familiar, e.g., other instruments, the sound environment, nature, industry, etc. If that sound is related to another or other instrument(s), then there will be some residual "baggage" associated with the music of that other instrument(s), some comparison made between what is known and the music being played on the experimental musical instrument. But not to worry! That is not the concern of the EMI improvisor. Any audience associations with the sound must remain purely personal to the individual audience listeners. The EMI improvisor is concentrating on his/her own sound world and how to get around in it in an interesting way.

For the EMI improvisor, the uniqueness of the sound of his/her instrument(s) might be considered the icing on the cake. The unusualness of the EMI sound holds a level of interest in and of itself — at first. But this uniqueness exists only as long as the instrument is very recently built and very new to the player. The sounds are too familiar to hold that initial level and type of interest.

So, the "icing on the cake" cannot be depended upon, because it goes away with familiarity, and all that's left is the musical ability and imagination of the improvisor.

THE EDGE

Finally, I would like to say a few words about my concept

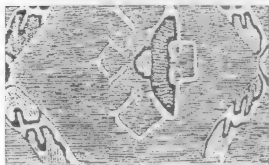
1. This gets into a very complex issue, beyond the scope of this article, around the role of the subconscious mind and the conscious mind in improvisation, their interaction and mutual cooperation. In reality, they are inseparable. But the roles these aspects of total consciousness play, and their relationships to one another in the improvisation process, are interesting to examine.

of good improvisation, no matter what the instrument(s), no matter what the player's experience, no matter what the style, no matter what. To me, that which makes a good improvisation good, or a great improvisation great, is simply this: it finds "the Edge."

This is a term heard a good deal in improvisation circles, though I'm sure many definitions could be offered. Let me define "the Edge" as the real-time process of uniting opposing forces. This union, just as in nature, generates (or releases) energy. We might liken this energy to level of interest in the context of improvisation. Pick a dualism, any dualism! How about a big one right off the bat: Beginner/Master, as in out-of-control/in control. This is at the heart of interesting improvisation (beginner's mind). The improviser is walking a fence between control and non-control, and other opposing forces — tone/noise, harmonic/textural, dense/sparse, fast/slow, and so on. The integration of these opposing forces, in my mind, is the basis for critical evaluation of the improvisation (if not just plain good mental hygiene). And it is important to realize this: The audience usually knows when an improvisation is on and when it is not, regardless of its background or relative familiarity with the performers or their music. So, it is incumbent upon us, as EMI improvisors, to be self-critical.

CONCLUSION

To sum up, experimental musical instruments are great for improvisation for many reasons, but they don't get you off the hook in improvisation just because they're different. On the other hand, to my mind, good improvisation with experimental musical instruments is an integral creative experience uniting two exciting disciplines which share so much in their openness to possibilities.



MUSICAL PILARS COMMENTARY

by Matthieu Croset

(Translated by Zack Rogo, Benemann Translation Center, San Francisco, CA 94102)

In the Tamil Nadu state of India's southernmost tip there are several Hindu temples dating back to the 7th century, wherein can be found sets of stone pillars. These pillars produce clearly musical tones when struck. They apparently have been deliberately tuned, showing well defined fundamentals with harmonic overtones, and were played in ritual contexts in the past. Farther north, in a temple at Hampi, is another set carved at a much later date. These, however, have lost their musical quality as a result of damage to the surrounding structure. The French musical instrument designer and researcher Matthieu Croset has visited and studied the pillars, and he sends the following notes, excerpted from a longer essay.

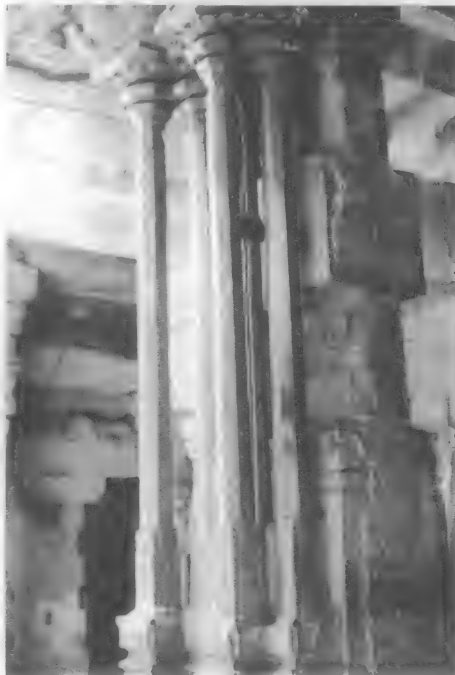
The musical pillars of Tamil Nadu are the ones that kept our attention. Those farther north at Hampi, which date back to 1635, that is to say, 1000 years later than the pillars of the south of India, are very deceptive. They are deceptive because they do not make a sound, though remarkably made and remarkably studied by Mr. and Mrs. Filiosat, who were kind enough to make it easier for me to visit this site and to get right to the heart of the matter.

It's true that the roofing at Hampi has fallen in, because time has done its damage and the construction work was never finished (this temple was not consecrated to Vishnu at the time of the war which broke out before construction was finished in 1635, date of the fall of Hampi: an internecine war destroyed all the temples). The temple was never perfectly maintained.

In Hampi we learned the technical function of the musical columns. The Hampi

columns are twisted after only four hundred years, while those of Tirunelveli, Tenkashi and other sites are completely intact after 1300 years of mechanical and acoustic functioning. The weight of the roof destabilizes the musical pillars at Hampi and inhibits lateral movement.

Thus, we were astonished by the sonogram to see that the harmonics were true harmonics. As for the pillars of Tamil Nadu, they are truly musical in the oldest temples.



MUSICAL PILARS IN TENKASHI'S TEMPLE

Photo copyright
Matthieu Croset



SCRAPYARD PERCUSSION

by Bill Sethares and John Bell

Metal scrap yards are often overlooked as a source of materials for musical devices. Yet there never seems to be an end to the variety of brake drum gongs, hub cap cymbals, dangling copper clangers, and aluminum rod bangers that can be resurrected from these metal morgues. Check your local yellow pages under "Scrap Metals" or "Surplus & Salvage Merchandise." Scrap yards tend to be rather forbidding places, filled with huge stacks of metal pipes and rods, old dead electronics, and large racks of unrecognizable equipment. Standard junkyard etiquette is to wander around, grabbing whatever seems interesting. Feel free to bang and clang things — no one seems to mind. Then look for someone to weigh your items. Almost everything is sold by the pound, with the price depending on the type of metal.

On a recent visit to the local scrapyards, we came home with a heating element, a small corrugated stainless steel tube, a coil of BX cable (a kind of metal-encased house wiring), two coil springs, and assorted metal saucers. After adding wood, wire, a couple of bolts, and a little bit of work to our collection of junk, we managed to make five musical instruments. While you probably won't want to duplicate our creations, a description of how we made them might give you some ideas to start you off on your own scrapyards ensemble.

The heater unit is about 10' long with dozens of thin aluminum rings radiating from its torso. Scraping nearly anything along these rings creates a hollow percussive sound, somewhere between the clink of an aluminum washboard and the croak of wooden fish scrapers you find in music stores.



The 125W

A heavy electrical wire dangles from the bottom, making an ideal holder. The only markings read "125W" from which the instrument gets its name. It's called "The 125W."

The corrugated tube makes a remarkable instrument. It is about 1.5" in diameter and 2.25' long, but because of its accordion-like corrugations, it can be compressed significantly. Holding it with the palm of your hand covering one end and your fingers over the other end gives you two distinct ways to manipulate the sound. Rubbing a stick across the corrugations creates a hollow zipping sound. Squashing the tube presses the ridges closer together and the pitch of the zip to rise. Raising one (or more) fingers off the end of the tube changes it from a closed to a partially open cylinder, causing a marked change in the timbre. Combining these two dimensions of control, and using various sticking techniques gives a surprising variety of sounds from a humble corrugated tube.

At first, the BX cable was just another scraper. (BX cable is a type of metal-sheathed housing wire, which resembles the neck of a goose neck lamp). We pulled out and discarded the

wires from inside the sheathing, fastened one end to a piece of wood and then stuck the wood to the wall with velcro. Scraping the sheathing gave a fine deep (and surprisingly loud) swish-scratch sound. Scraping with a drumstick, an aluminum tent pole, or a beer bottle created distinct sounds that unfortunately never seemed to last long enough. We could make the sounds last longer by using a longer piece of cable. The hard part was finding a longer arm to match.

Since lengthening my arm seemed as if it might involve significant pain, we curled the sheathing into a circle, creating the "Infinite Scraper". To make your own, cut a wooden handle with the same curvature as the BX cable, and drill holes along the edge of the handle which are spaced coincident with the corrugations in the cable. Get some thin wire and wrap it through the holes in the handle and around the BX sheathing. The wire will hold the sheathing to the handle, and holds the ends of the sheathing into a circle. See the picture. There are two basic playing techniques. With a continuous circular motion, the scraper scratches out a sustained clacking whose timbre depends on the character of the stick (whether hardwood, bamboo, plastic or metal). Alternatively, by moving the scraper up and down, hitting the circular cable on both up and down strokes, a sharp attack with rapid repeats is possible.

The last pair of instruments we made turned out to be the most unusual. The plan had been to use the two saucers as cymbals suspended from the ceiling by springs. Accordingly, we drilled a hole in the center of the saucers and bolted the springs firmly in place. The resulting bouncing cymbals were somewhat disappointing. The spring added nothing substantive to the tone or sustain of the cymbal. Besides, bouncing cymbals were hard to hit. Enter musical serendipity...

Hold the spring and let the saucer dangle. Striking the spring gives a long "underwater" sound, reminiscent of the "sonar" sound effects on *Voyage to the Bottom of the Sea*. Have you ever thrown a rock at a water tower? Even more interesting sounds result from holding the saucer while the spring dangles. Striking the center of the saucer causes a sharp second echo and then a long reverberation that dies away slowly. Plucking the string gently makes the gentle drip of water in a deep reverberant cavern. This may be the only instrument in which you can see the longitudinal waves vibrating with each reverberation. Shaking the saucer causes the spring to dance — a subdued roll that slowly builds into thunder. When the spring collides with itself (or with the saucer), it's like the rain pounding. Hit the dancing spring and you've got a sharp lightning bolt crackle. Now, every instrument needs a name. These long coiled springs dangling at the ends of hubcaps look like... look like... automobile sperm. Yes, that's it, let's call them "Singing Automobile Sperm".

By night, Bill Sethares is a denizen of noisy places, and nothing amuses him more than inducing rapid oscillations in the air. At daybreak, he transforms into a mild-mannered engineering professor.



Above: SINGING AUTOMOBILE SPERM.

Below: The Infinite Scrapper



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INTRODUCTION TO SPECTRUM ANALYSIS

By David R. Courtney, Ph.D.

INTRODUCTION

The technique of designing musical instruments has not changed much in the last several thousand years. A maker builds an instrument, listens to the tone, then repeats the entire process with a slight change in construction. This is a tedious process and one often thinks that it could be easier if there was a way to "see" the sound. Spectrum analysis is a tool that gives us the ability to see the timbre. In this article we will discuss its various aspects; including sampling theory, processing, and graphic output.

BACKGROUND

The graphic representation of sound has been an area of interest for years. The earliest experiments focused beams of light against a mirror which was attached to a vibrating object. This technique was used extensively until the twentieth century when the oscilloscope was invented. Both light beams and oscilloscopes give a graphic representation of the vibratory nature of sound.

Musical sounds are usually visualized as "waves" of air that vibrate with a particular frequency. This frequency is expressed in cycles per second; however, instead of saying "cycles per second" we say "Hertz". The range of human hearing is said to extend from 20 Hertz to 20 Kilohertz (i.e., 20 cycles to 20,000 cycles-per-second). This range is referred to as the "audio spectrum".

However, day-to-day sounds and musical sounds consist of a mixture of different frequencies. It is the nature of this mix which helps to determine timbre. Therefore, by looking closely at these component frequencies we get insight into the timbre of any sound. This is spectrum analysis.

The pioneer of spectrum analysis was undoubtedly Hermann von Helmholtz. He developed a series of hollow glass spheres with carefully calibrated resonance frequencies. They

would vibrate when excited by the appropriate frequency and one could hear this by placing them against the ear. It was a very tedious process, but with these simple devices he was a pioneer in the field.

The Helmholtz resonators had their problems. They were awkward and the lack of a graphic output meant that only a subjective evaluation of the component frequencies was possible. By the later part of this century they were replaced by totally electronic techniques. Unfortunately, they were very expensive.

However today these once expensive spectrum analyzers are within the reach of the average instrument maker. This is a consequence of the rapid drop in the price of digital electronics. \$200 and a personal computer is all that one requires to enter the world of spectrum analysis. Table 1 is a small list of available packages.

We have briefly reviewed what spectrum analysis is. It would be very appropriate to discuss the technical details. One of the most fundamental is the process of taking the sound and putting it into the computer. This is a process known as sampling.

SAMPLING

If the computer is going to do our work, we have to find some way to get the music into the computer. The hardware and software, with all of the myriad of technical considerations, has been the topic of numerous books and dissertations. However the essentials are surprisingly simple. The hardware in our sampling process revolves around a specialized peripheral called an Analog-to-Digital converter. This device, usually called A/D converter for short, is responsible for taking the analog signal and converting it into discrete numbers that the computer can process. These discrete numbers are our samples.

The concept behind sampling is quite simple. The waveform in figure 1-A can be sampled and expressed as figure 1-B. This is similar to the operation of a motion picture camera. Just as an event may be captured on film as a series of still frames, so to an audio signal may be captured as a series of discrete values.

The sampling rate (the frequency with which the samples are taken, expressed as samples per second) is an option on

TABLE 1

| PRODUCT NAME | HARDWARE ENVIRONMENT | MANUFACTURER | STREET PRICE | COMMENTS |
|--------------------------|----------------------|-----------------------|--------------|---------------------|
| Digital Sound Studio | Amiga | Great Valley Products | \$100 | Hardware / Software |
| Compuscope / GageCalc | IBM | Gage Applied Sciences | N/A | Hardware / Software |
| MacRecorder Sound System | Macintosh | Macromind | \$175 | Hardware / Software |
| MacRecorder Pro | Macintosh | Macromind | \$240 | Hardware / Software |
| Alchemy | Macintosh | Passport Designs | \$695 | Software only |

most computer systems. But how fast should it be?

We must turn to the Nyquist theorem to help us find the correct sampling rate. It tells us that the sampling rate must be greater than twice the highest frequency to be encountered. Any attempt to sample at a lower rate results in a phenomena known as aliasing.

Aliasing is where the frequencies above the Nyquist point (half the sampling rate) become reflected back down the audio spectrum. This is illustrated in figure 2. It is very much

like the movement of the wheels in the old films. If the wheels are moving slowly, the camera has no trouble "sampling" the event. However, as the wheels go faster the apparent motion tends to slow down. At a certain point the wheel appears to stop, thereafter it appears to go backwards. This apparent retrograde motion of the wheels is analogous to the aliasing which occurs in digitized audio signals.

The resolution is another consideration. Most low cost systems default to eight bits. An 8-bit code has 256 possible combinations. Therefore the maximum resolution that one could expect from an 8-bit code is 256 steps. There are systems which are capable of processing up to 16-bit codes. This gives 65,536 possible steps! However these systems cost more than the average instrument maker would be willing to spend. For the purposes of the average craftsman an 8-bit resolution is quite sufficient.

This digitizing process, with all of its considerations is the first step. However merely putting the information into the computer is insufficient to produce any useful result. The data must be processed to yield the frequency information.

PROCESSING

The key to spectrum analysis lies in the computer processes. These processes are variations upon an extremely complicated field of mathematics known as Fourier transforms. The utility of the Fourier transform is underscored by the failure of simpler methods to yield clear information about musical timbre.

The oscilloscope is a classic example of the inadequacy of a simpler technology. Virtually any instrument maker can afford to purchase an oscilloscope. Yet the images that appear fail to give much information about timbre. It fails because the oscilloscope functions in what is called "Time domain" while our perception of timbre depends upon something called "Frequency domain". These are referred to as "inverse domains" of each other.

The concept of the inverse domain may sound very intimidating but it is based upon a simple idea. Let us begin by looking at figure 3. Here is a simple question. Which one is the quarter? We know that both images represent the same object even though they look absolutely nothing alike. Once we accept the fact that totally different images may represent the same object, we have made the first conceptual breakthrough in the understanding of inverse domains.

A further understanding of inverse domains is seen in common wall current. Wall current (60Hz, 120V) is graphically shown by the two diagrams in figure four. Figure 4-A shows voltage as a function of time. This is the standard sine wave which is familiar to most people. Figure 4-B shows voltage with respect to frequency. This shows a single spectral line at 60Hz. It does not require a strong technical or mathematical background to see that both of these diagrams represent the same phenomenon.

The reason that these two representations are referred to as inverse domains is equally simple. The time domain diagram (fig. 4-A) shows the period as being .01667 sec. The Frequency domain (fig. 4-B) shows the frequency as being 60Hz. The relationship is simple:

$$\text{FREQUENCY} = \frac{1}{\text{PERIOD}} \quad \text{PERIOD} = \frac{1}{\text{FREQUENCY}}$$

We see that this is a simple reciprocal relationship. It is

A) ANALOG WAVEFORM



B) DIGITIZED SAMPLE



FIGURE 1: Analog waveform and digital equivalent

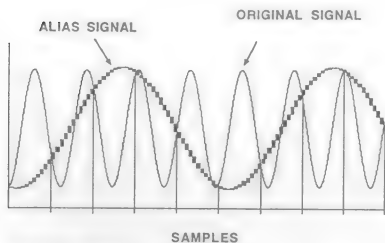


FIGURE 2: Aliasing



FIGURE 3: Which one is the quarter?

because of this simple relationship that they are called inverse domains.

Unfortunately, the real world conditions do not allow us to take a simple reciprocal and obtain our spectra. To derive spectra from complex sounds we are forced to perform what is called a Fourier transform.

The Fourier transform may be visualized as a magic "Black Box" which is able to convert time domain to frequency domain. There are numerous algorithms to accomplish this, however the most common is a algorithm known as the "Fast Fourier Transform". This particular algorithm is usually abbreviated as FFT. The FFT is the most commonly used algorithm for small computer systems.

The Fourier transform was developed by Jean Baptiste Joseph Fourier in the beginning of the 19th century. The life of Fourier would make an interesting book in its own right. He was successful at politics, sciences, and mathematics. It is also curious that the mathematical process that made him immortal was not developed for acoustics. It was instead developed during the course of his work on thermodynamics. However to us it is his "black box" that converts time domain to frequency domain which is important.

Although the Fourier transform may be visualized as "black box" there are still some considerations which should be observed. Primarily we need to keep in mind the effects of our sample.

The size of the sample is extremely important. This is because the amount of information which goes into the process is going to be the same as the information which comes out. The Fourier transform merely changes the form of the information. It does not generate nor destroy information. Therefore a larger sample will give us a higher frequency resolution. Let us say that we transform a sample which has 1024 points. Our output will have 512 frequency bands.

At this point the attentive reader will be saying "Hey, that is only half the information which went into the transform. Where did the other information go?" This would be a convenient place to zoom into the stratosphere with an esoteric discussion of imaginary numbers, but we will not do that. The simple fact is that the other half of the information is the phase relationship of the various frequency bands. Therefore the 1024 point sample was transformed into 512 frequency bands and the corresponding 512 phase relationships. However, this phase information is generally ignored.

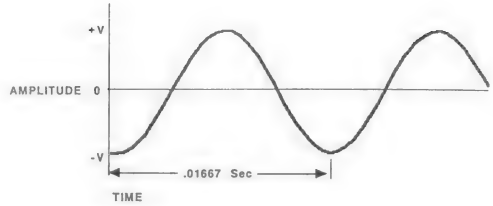
There are situations when a characteristic of the sample produces a frequency which is not in the original. This is called an artifact. Aliasing is one example of an artifact.

There is another artifact which is particularly troublesome for the Fourier transform. This arises when the sample does not correspond to an even number of periods. We find that the Fourier transform presumes that it is dealing with an even number of periods and generates the frequency information accordingly. Therefore the presumed waveform from the sample in figure 5-A would be the waveform in figure 5-B.

This artifact points to a fundamental weakness of the Fourier transform. The process presumes that there is a repeating pattern and that the sample conforms to an even number of periods.

Unfortunately, real world sounds tend to show an absence of such simple repeating patterns. This absence is usually

A) 60 Hz WALL CURRENT (TIME DOMAIN)



B) 60 Hz WALL CURRENT (FREQUENCY DOMAIN)

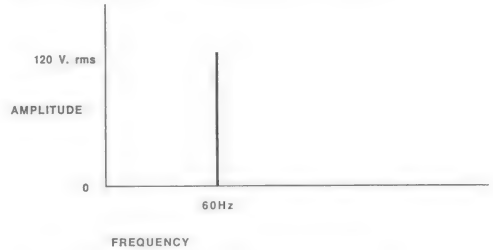
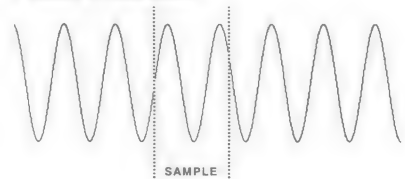


FIGURE 4: Time/Frequency domain of 60Hz wall current

A. SAMPLE OF SINE WAVE



B. PRESUMED WAVEFORM BASED UPON SAMPLE

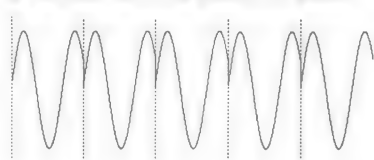
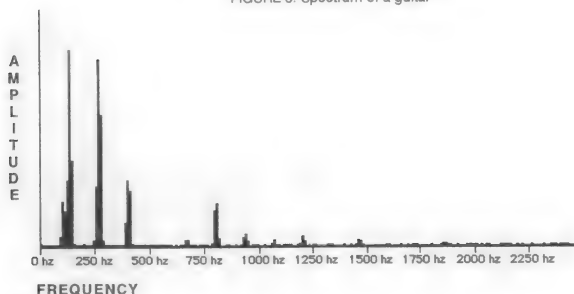


FIGURE 5: Sample of sine wave and presumed waveform based upon the sample

FIGURE 6: Spectrum of a guitar



derived from several mechanisms. The first is a random component in the sound (i.e., white noise). Another is the effect of the envelope (i.e., the attack and decay of the sound). And another deals with different envelopes for each component frequency. Although such fundamental inconsistencies exist between the presumptions of the Fourier transform and the real world, this does not weaken the value of the process. It merely means that we must be conscious of the artifacts and how they may influence our final results.

Usually these artifacts are of such a low amplitude that we do not need to worry about them. However, if one suspects that an area of interest may be an artifact, the

easiest thing to do is to resample with a different sample size. If the particular component shows wide variation, it is probably an artifact. If it shows a certain consistency then it is probably a legitimate component.

We have seen that the Fourier transform is the major tool by which we are able to obtain the frequency information from a sample. We have also shown that there are certain considerations which should be observed if the transform is to be reliable. However we have not discussed one of the most important aspects of the process. That is the graphic representation of the information.

OUTPUT

The output of the spectrum analyzer is of prime importance. This is what is going to be interpreted by the instrument maker. An unintelligible output renders the whole system worthless.

Undoubtedly a simple numeric table would be the most fundamental computer output. After all, the Fourier transform is just a mathematical process which takes in number and spits out numbers. Unfortunately, this is not an intuitive way to read the data. It is for this reason that a numeric output is not common for spectrum analyzers.

The simple X/Y plot is the most common form of output. This simply plots the data from the Fourier transform in standard Cartesian coordinates. The X axis is conventionally fixed as frequency and the Y axis is conventionally fixed as the amplitude. Furthermore there is a tendency to "fill" the diagram to make it visually more appealing. Figure 6 is a typical X/Y spectrum of a guitar with a black fill.

The simple X/Y has one disadvantage. It does not have the ability to show how the spectrum changes with respect to time. It is a characteristic of acoustic instruments that the spectrum is not fixed but changes over the course of time. If we take repetitive samples and plot them on the Z axis, then we can better illustrate the timbre of an instrument.

This is the principle behind the 3-D wireframe. In figure 7 we see a 3-D representation of the sound of a mridangam. There are several characteristics which may be seen that would not be apparent in a simple X/Y plot. For instance there is a moderate component of white noise (random vibration) in the initial sounding. This is indicated by the unusually broad peaks and the large degree of filling between them. The initial spectrum very quickly dies away and is replaced by a relatively stable 2nd, 3rd, and 4th harmonic. There is a peak in the second harmonic at an unusually long period after the drum

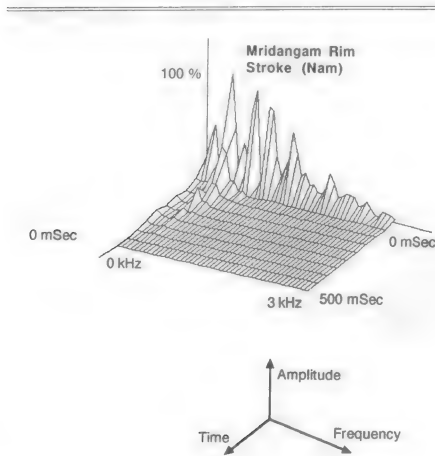


FIGURE 7: 3-D wireframe spectrogram of East Indian mridangam

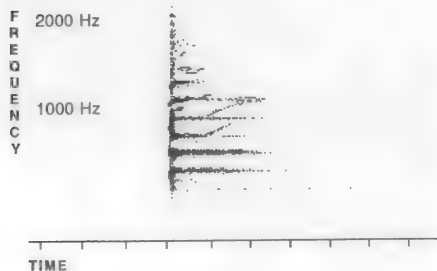
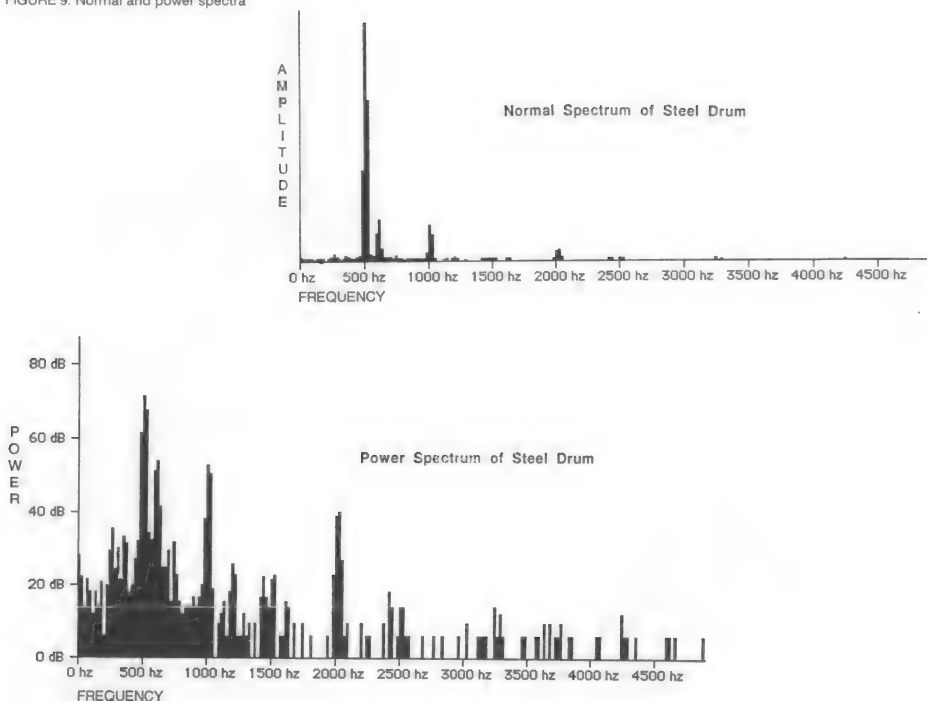


FIGURE 8: Sonogram of Pakhawaz "Ta"

FIGURE 9: Normal and power spectra



was excited. All of these are characteristics which are clear when viewed as an 3-D wireframe but would not be so evident in a simple X/Y plot.

There is another way to represent the same information in a 2-D format (fig.8). This is in the form of a "sonogram". This particular form of representation gained wide popularity in the pre-computer era because it lent itself well to analog techniques of spectrum analysis. This technique uses the X axis to display time and the Y axis to portray frequency. The amplitude is denoted by the darkness of the print. This method is still in use today in voice-print analysis, however for virtually all other applications it is on the decline.

All of the previous examples utilized a linear method of presenting the information. That is to say that each unit of time or voltage corresponded to a single unit of vertical or horizontal displacement. However, this one-to-one relationship is inconsistent with human perception. Haven't you always wondered why when you walk into a dark room and turn on a light it gets bright but when you turn on two lights it doesn't get twice as bright? This is because human perception is not linear. Sometimes spectrum analyzers allow you to look at the spectrum in a nonlinear fashion somewhat analogous to the way we hear. This is referred to as a power spectrum while the normal linear graph is referred to as a normal spectrum. Figure 9 (A&B) shows both the normal spectrum and the

power spectrum of steel drums.

It is apparent that the power spectrum shows much more detail than the normal spectrum. Unfortunately it takes some practice to properly interpret the relative values of the component frequencies. The choice between displaying the power spectra or normal spectra is often a question of personal choice.

We may summarize the whole topic of output quite simply. Although the output from the Fourier transform must be numeric, virtually every package gives a graphic output. These may take the form of a standard X/Y plot, the older spectrogram, or the much more attractive 3-D wireframe.

CONCLUSION

Spectrum analyzers are not out of the reach of the common man. Software/hardware packages are now in the range where almost anybody can afford one. However, the complexity of the subject still means that there has to be a certain attention to detail. If the nature of sampling and the quirks of the Fourier transform are known, it may be a useful tool for virtually any serious instrument builder, especially with an appropriate graphic output.





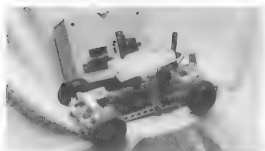
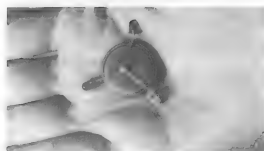
SOUND THEATER

CIRCUIT-BENDING and LIVING INSTRUMENTS

BY QUBAIS REED GHADALA

The element of discovery has a special allure. The course of its pathways and revelations entice and mystify, tangling together art and science in a wild history of consequences. And so we find that to explore the origin of our subject - experimental electronics - even the dark forests of pre-history played a fabled role. It's the sap of these ancient trees that, over time, hardened to form the precious golden material known as amber ...the same amber that Thales was so intrigued by in Greece, back in 600 B.C.

In the noted experiment, Thales discovered that nodules of amber rubbed with wool could, like a non-metallic magnet, attract small particles by means of some mysterious and unseen force. The energy at work within the amber was, of course, the same electricity that's at work in all our electronic instruments. And just as it was with Thales, the trail of discovery for the experimental electronic instrument designer is similarly based upon the control and manipulation of electrons, the name 'electron', in fact, stemming from the Greek word for amber. But it's not only the customary paths of these electrons, a scintillating fabric of energy traveling near the speed of light and named after tree sap, that I'm concerned with... the truth is, the most alluring realm of electronic discovery for me has been based upon sending electrons where they were never meant to be sent at all... I call this CIRCUIT-BENDING...



CIRCUIT-BENDING AND LIVING INSTRUMENTS, by Qubais Reed Ghazala

(continued from previous page)

Maybe I should digress for a moment.

For better or worse (the verdict is not yet in), I started listening to electronic music when I was one or two years old. Do you picture me toddling down to the record shop and thumbing through the Avant-Garde bin? No, what actually happened was a little less picturesque, though I'll remember it forever. My mother brought home a few of those kiddie records - colored vinyl 45s. One of them was entitled something like "Ohmichron and Nutnichron", the tuneless adventure of two lost travelers from outer-space, temporarily stranded on planet Earth. What I really liked about it were the streams of early synthesizer sound effects that ran through the whole thing ... abstract and gripping, electronic music for kids! For some reason, these strange blooms of noise amazed me. I must have listened to Ohmichron and Nutnichron hundreds of times. From that point on, I did all kinds of things to hear or create odd sounds. But to try to make a long story short, my fascination with unusual music has, over the years, expanded into the collecting and creating of strange musical instruments, as well as recording experimental music under the title of *Sound Theater*, with work now circulating on CD's, cassettes, and like Ohmichron and Nutnichron, a 7-inch single (see the discography at the end of this article).

Like many modern composers, I consider the world to be my orchestra. Similar to the painter's palette, upon which all possible colors are accepted, is my palette, containing all possible sounds. And why not? Color and sound, both wave-

form phenomena, each rich in emotional and descriptive power, standing upon equal ground. Each to be manipulated as freely as the other in the pursuit of aesthetic creation. Within the rich terrain of this conclusion there lies a Never-Never Land ...



Qubais Reed Ghazala. bending circuits

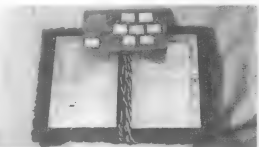
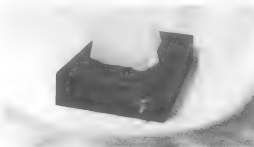
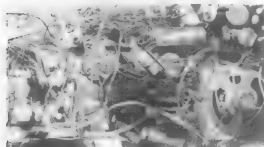
I'm certainly not the first person to have discovered that weird things happen to audio electronics when you short-out their circuit boards in just the right places. Such creative short-circuiting is what I refer to as Circuit-Bending. This process is at the heart of many of my instruments, the specifics of which I plan to cover in later issues. For right now, I'll just touch on the general practice of Circuit-Bending, to simply lay the groundwork.

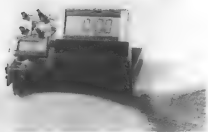
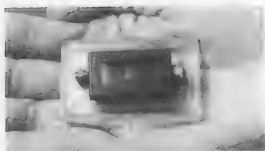
In place of the amber, we now have an audio circuit board of some type to experiment with, which is fairly significant in more than one way.

In Thale's time, the arena of discovery was invitingly open to the layman. Today, however, it seems as though corporate monopolization and private R & D labs have successfully distanced the "threshold of invention" from the common person. Circuit-Bending changes all this. Additionally, to have a working, complex circuit-board to serve as the starting-point for our explorations presents us

with what in some cases is an audio wonderland waiting to happen ... the best boards amounting to intricate mazes or catacombs of fantastic sound-forms to uncover.

It's best to start with a circuit board that has two basic qualities. Number 1: It should be cheap enough that destroy-





ing it through the experiments, which is always a possibility, won't bother you too much.

Number 2: Choose a device that is easy to open (screws), and has lots of accessible internal electronics (which can sometimes be seen through the battery doors or other openings in the case).

Just about any battery-powered, low-voltage audio device is worth experimenting with. But *don't* try the following procedures with any devices that run on house current unless you're familiar with working on 110-volt systems. As a general rule, I use only devices operating on nine volts or less for circuit-bending. Also, I rarely spend more than five dollars on a device, many being bought for a buck or less.

As you might have guessed, I don't buy these devices new. Places to search include second-hand shops, garage sales, rummage sales, flea markets, and charity retail outlets such as Goodwill, Salvation Army, St. Vincent De Paul, and Amvets. Also check warehouse auctions and going-out-of-business sales. Ask electronics store managers what they do with their damaged stock. You might be able to buy a box of usable parts or possibly even get their discards for free. Even department store dumpsters are worth a look!

I seem to be able to find an endless supply of usable circuits through these local sources. Devices to look for include battery-powered amps for telephone, instrument, computer or related use (which usually run on a single 9-volt battery, and are quite small), as well as radios, tape players, and the occasional worn-out fuzz-tone, wah-wah, phase shifter, or other dated effects box. But I'm really impressed by the circuit-bending possibilities within children's audio toys. A couple of my most outrageous and complex instruments are based upon the intricate sampling electronics hidden within

recent teddy bears! Space-guns, games, toy vehicles, small musical keyboards and other instruments, walkie-talkies, bike horns and other noise-makers, talking dolls, speaking educational toys, etc., etc., etc., can all be circuit-bent.

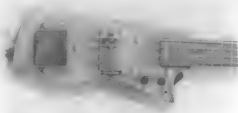
Before I get into the actual process of circuit-bending, there's a very interesting concept to be considered. The concept is that of creating a "living instrument", an instrument very different from the sound-producing electronics that we're all familiar with. Because, as I stated before, the procedure of circuit-bending is one of an exploration

through creative short-circuits, there is the possibility that the resultant modified device will contain new wiring that causes voltage and temperature thresholds of the original circuit to be surpassed. In effect, this thermal overload produces a force that can change the various electronic values of the circuit over a period of time ... minutes, years, decades. Most of the thermal changes are too small to be able to actually feel. In fact, if the bending of a circuit causes any component on the board to warm up significantly I always remove the offending connection no matter how great the sound produced might have been. Not all circuit-bending produces such a device, but those modifications that result in the slow burn-out of an instrument, like the process of our own aging, leave us with an instrument that has a definite life-span over which it and its voice will change, just as it is with you and me.

It could be said that all instruments, electric and acoustic alike, have life-spans and will evolve in both a sonic and physical sense over time. Of course, this is true. But whereas there are examples of fine string and wind instruments whose tonal qualities are said to mellow and strengthen over time, the greater concern of traditional fine instrument builders is



Plans and original module for HARMONIC WINDOW



always that of creating an instrument that will, first, produce a musical voice of superior quality, and second, be built in such a manner as to protect that voice for as long as possible from the destiny that time must inevitably demand. The circuit-bent "living instrument" has made peace with time. There is no battle perceived. The finite life-cycle of a living instrument is something I accept as being natural and intrinsic to its being, function, and its purpose.

We're not used to thinking of our instruments the way we think about our friends, our pets, or for that matter, our house plants ... that they're living entities and a little bit older and different every day. We expect our keyboard or reverb unit to do tomorrow exactly what it does right now. But if we're asked to consider an instrument as a thing that changes, ages, and someday dies, how then will our behavior toward it be altered?

I suppose a person could be tempted to try to "save the life" of a living instrument by not using it. I've felt this way at times, and I can't tell you if my occasional decision to use a standard instrument instead of a living one for a piece of music has kept me from a further discovery or not. I can tell you this, however ... a living instrument seems to automatically create in the player, if not an unusual *degree*, then at least an unusual *angle* of consideration.

Anytime a musician builds an instrument there is automatically created a closer relationship between the person and the instrument than if the device were mass-produced and had simply been purchased. Add then to this the effect upon the user of operating an instrument in possession of a voice-evolution including a distinct infancy, childhood, adulthood, and an eventual collapse into silence. There have even been times when living instruments cried out upon initial power-up as their new circuits stabilized, reminding me of a baby's first cries of birth.

So yes, while it's true that circuit-bent living instruments do inspire an uncommon respect in their creators, ultimately it is realized that for them to live at all they must be used, they must age, and they must eventually die. The breath of their existence would be lost if their "lives were saved" for fear of turning them on.

I'm reminded of a similar situation and tough decision I had to make a few years ago. While hiking the forests along Lake Superior on a cold autumn day, I discovered an old deer skeleton off to the side of a sheltered and overgrown trail. All the bones were there except the skull, which I could find nowhere around. I soon realized that the bones were probably the remains of a "trophy" kill, the head having been removed for mounting. Through my own experiences of recording and photography I've developed a considerable degree of respect for the abilities of the deep-woods tracker able to read the

many stories written in the subtle disturbances of the terrain, but for the culmination of these skills to result in the killing of an animal for the sake of souvenir is an act that I see as cruel and unconscionable. I felt a strong desire to try to salvage the dignity and intrinsic beauty of this animal that had been so grossly violated by the sportsman.

I sat down amidst the bones and struggled with the thought of collecting the time-bleached remnants of this organic living instrument, disturbing their placement to reassemble them into an art-piece of some musical or kinetic nature. But I really wasn't sure if I should remove them at all. I sat for a long time tapping the bones, listening to them, pondering their place in the world ... then I asked myself: What if these were my bones? Would I rather they be lost, trampled underfoot, a silent testimony to a heartless and wasteful act, or would I rather their story be told and their voices be heard in the form of an instrument of some type to be played and pondered?

I collected the bones along with some driftwood and returned to camp to begin the construction of two great-sounding

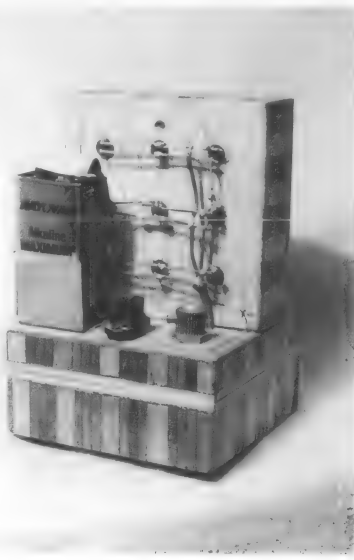
xylophones which today are on display in my home and have been used for recordings that are now heard far and wide. I can only hope that the deer would approve of my decision which, as it is in several ways with circuit-bent living instruments, favors active usage and exploration over the opposite — a slumber of wondrous potential.

The actual process of circuit-bending is really very simple. You don't have to possess any difficult skills or know even a bit of electronic theory. However, if you have never built an electronic circuit, I strongly recommend that you buy a couple basic kits to assemble before you begin bending. These will teach you how to use the basic tools — low-wattage soldering iron, wire, wire strippers, switches, components, etc. While the techniques involved in electronics are within the grasp of everyone and take only a little practice to learn, their generalities are still outside the scope of this article and will be

much better taught by writers devoted to the subject (see below). Don't be put-off by the mystique of electronics. You're not going to be electrocuted and nothing's going to blow-up as long as you follow the simple rules. But, as I said, if you're an electronics novice, *DO* familiarize yourself with the basics before you begin to bend.

So now let's assume that you're comfortable with the low-wattage soldering iron, you know how to wire a simple switch, and you have a drill for mounting switches onto a panel.

The first step is to open the audio device of your choosing to expose the circuitry. Once this is done, try to locate where the battery voltage enters the circuit-board and, as a general rule, avoid this area during your jumper tests, which are the



MINIATURE MOSAIC LIGHTBOX (back view). Custom electronics.

first steps of exploration. To make the wire jumper, just strip about 1/2" of the insulation from each end of a wire that is itself about twice the length of the board. If your jumper is made up of many thin wires twisted together inside the insulation (stranded wire), it will help to solder or "tin" the exposed ends to firm them up and keep them together. Turn the device on and have it produce its normal sound. (Hold down keys, buttons, etc., with pieces of tape or paper wedge). In the case of an amp or other passive circuit, just turn it up about one-third of the way, or send a signal from another expendable device through it. You're now ready for the first audible circuit-bending tests.

Choose a point on the circuit-board, away from the battery leads, where you can touch one end of the jumper to bare metal — the path of a conductive trace on the board, or the metal lead of a component itself. Keep that end there. With the other end of the jumper, cautiously begin to touch various additional points on the circuit while observing any changes in sound. At first, touch the traveling end of the jumper to the decided point only very briefly, just for a moment. If you hear a loud "pop" from the speaker, or if the speaker goes dead or just loudly hums, don't push your luck ... go to the next point and try again.

Good circuit-bending points produce unusual tones without great changes in volume. Make a chart of successful bending-points or code them right on the board with a marker. Once you've touched a number of points with the traveling end of your jumper, move the stationary end to a different point and start all over.

Once you're done with this process, if you're lucky, you'll have discovered a number of jumper paths that result in interesting effects. The next and simplest thing to do is to cut a series of jumpers to facilitate the creative short-circuits you've found, the idea being to solder these in place to gain access to the various new sounds produced. However, you'll need to place a switch in the middle of each wire to enable you to choose which effect, or combination of effects, you want to turn on. I should note here that although individual jumpers alone may have no adverse effect upon the circuit, turning several, or even the wrong two on at once, can cause threshold problems as mentioned earlier. That having been said, the next logical step is to mount the switches on a case that will now protect the modified device. If there's room on the original case for these switches, fine. If not, put the whole device into a larger enclosure of some type and mount the switches (volume control, speaker, power switch, etc.) on that. These are the beginnings, the very basics, of circuit-bending.

The elaborations possible with circuit-bending are end-

less. Future installments of this column will bring some of these to light. For example, you can interrupt or replace the jumpers with resistors or capacitors as well as other components for added effects. With a multi-position rotary switch it's possible to turn one circuit-bending point into a series of effects by connecting a different component (resistor, capacitor, etc.) to each of the switch's terminals. You'll find circuit-points that alter functions other than audio. You'll discover points that light LEDs for status indicators, even contacts that will conduct current through your body for the ultimate living instrument/living instrument bio-modulation possibilities.

Admittedly, if you do approach circuit-bending with only minimal prior experience, the initial attempts will probably be very haphazard. Still, circuit-bending can inspire experiment after experiment, teach you a lot about electronics, and help you create your own orchestra of unique original experimental musical instruments.

I'm a mushroom hunter. There are a few mushrooms at the side of the trail that can kill you. The dangerous ones are easy to avoid, leaving all the rest, with their various rewards, open to the curious explorer. It's the same with electronics. All of the following cautions should be respected and heeded.

SAFETY RULES OF CIRCUIT-BENDING

ONLY USE BATTERY-POWERED DEVICES OF NINE VOLTS OR LESS. Higher voltages can be dangerous. House-current (110 V line-supply) is definitely too much to fool around with if you're not an experienced technician.

ALWAYS WEAR PROTECTIVE GOGGLES. Only once in my 25 years of continual circuit-bending have I ever had a component explode, and it was due to a foolish mistake on my part ... I blew-up a transistor on a "Speak 'n' Spell" by attaching a power-supply of twice the required voltage. It was a nice flash though.

BE AWARE OF THERMAL

CHANGES. Feel, with caution, the working circuit before you begin to bend it. Some parts may naturally heat-up. If any thing gets a lot warmer it's probably wise to remove the cause.

FOLLOW THE BASIC CAUTIONS OF PROTOTYPING. Read up on circuit building (see below). Learn which electrolytic capacitors are dangerous and avoid them. Such larger capacitors will be absent from most small circuit-bending targets, but it's good practice to treat any electrolytic larger than a cigarette filter with respect. The stored charge of a large capacitor, such as those that supply the zap for photographic strobes, have the power to melt the tip of your pliers and knock you across the room!



BOVINE BALLET. Custom electronics

After all this, you might still ask — but why circuit-bend? How could a short-circuited toy compare to the superb electronics of pro audio equipment? To this, as an avid instrument builder and collector, I must answer that the question is not one of comparisons. The bottom line is that every instrument has its own voice, its own emotional sound-form to present. I should mention that I have no dislike for traditional circuit-building. I start many projects by drawing a schematic upon which to base the entire assembly, as is the standard procedure. This approach is usually rewarding and I end up with what I bargained for. But with circuit-bending you simply never know what you're going to get, and I find the discovery fascinating.

Most importantly though, in addition to the fun of the circuit-bending process are the bizarre sounds and special voicings often achieved, the likes of which certainly break new ground. If the modern synthesizer is to be accepted for what it is, a logically organized theory-true machine, then the circuit-bent instrument must be accepted as being based upon the chaos of wild chance and outlaw experiment ... elements dramatically reflected in its unorthodox phrasings. While many of my devices would certainly constitute an electrical engineer's nightmare, to me they are crystalized wonderlands of sonic eccentricity. And I must try to convey that in this society of mass-production and conformity there is something truly satisfying about sitting down with a uniquely-voiced living instrument that not only defies the design-standards of its field, but also exists nowhere else in the universe.

Many people are interested in custom audio electronics. It will be the on-going purpose of this column to address this subject using various sources for illustration. Along with discussions of my own inventions, I hope to get into the general concepts of developing experimental instruments, and how their often unusual playing techniques can set the stage for performance art. There will be a schematic or two, a little history, and probably a few hair-raising personal experiences as well. Beyond all this, I will try to demonstrate that the fascination of building experimental electronic instruments is available to any audio explorer who cares to give it a go.



ECHO LEG

Circuit-bent
echo toy.

DISCOGRAPHY

Cassettes:

| | |
|---|---------|
| A Watch in the Sea | ST |
| Sound Theater One: Music and Event | ST |
| Sound Theater Two: Visions | ST |
| Mind Over Matter | ST |
| Suite for Radio and Turntable: Outdoor Celebrations | SOP, ST |
| Voice of America: an Industrial Opera | SOP, ST |
| Posters in the Underground | SOP, ST |
| Natural Sciences | ST |
| Requiem for a Radio | ST |
| Artifacts | ST |
| Behind the Emotional Mask | ST |
| The Sound Theater Radio Special | ST |
| Bring your Room | ST |
| Vinegar Versus Cats | ST |
| Spzz Tapes | ST |
| Go Mad Xmas | ST |
| Cool and the Clones — Clones and Friends | EJAZ |
| Cassette Mythos: Feast of Hearing | CM |
| Assemblage 1990 | RR |
| Anti White Bastards | PBK |
| Cassette Mythos: Audio Alchemy | WNR |
| Electricity | PM |
| Postal Sound Surgery | PM |
| Gawk: Lore of the Ox Owl | SAC |
| Gawk: Marc Sloan, Reed Ghazala | ASK |
| Psychic Rally: Montag, 23, Marz, 1992 | PR |
| Objekt 5.5 | LF |
| Burning Suns of Shadow Worlds | LF |
| Compact Discs: | |
| Cassette Mythos: Audio Alchemy | WNR |
| 4 x 4 | LF |
| Objekt 5 | LF |
| PBK | RR |

Vinyl:

| | |
|------------------------------------|---------|
| A Darker Solvent / En Terres | EDICION |
|------------------------------------|---------|

Labels:

| | |
|-----------------|----------------------------|
| ST | Sound Theater |
| SOP | Sound of Pig |
| SAC | Sacrifice |
| ASK | Askance |
| PR | Psychic Rally, Switzerland |
| RR | Realization Records |
| WNR | What Next? Records |
| PM | Pointless Music |
| LF | Ladd / Frith |
| EDICION | Edicion, Spain |
| PBK | PBK — USA |
| KORM PLASTICS — | The Netherlands |

REFERENCES

On learning electronics:

Electronic Projects for Musicians by Craig Anderton (Amsco Publications)
Getting Started in Electronics by Forrest Mims (Radio Shack Publications)
Engineer's Notebooks 1 & 2 by Forrest Mims (Radio Shack Publications)

On kit building:

Radio Shack, Tandy Corporation (retail outlets)
Paia Electronics (Box 14359, Oklahoma City, OK 73114)
Heathkit (Benton Harbor, MI 49022)
Southwest Technical (219 W. Rhapsody, San Antonio, TX 78216)
Many of the scores of electronic parts catalogs also carry kits.

Qubais Reed Ghazala and SOUND THEATER can be reached at 3325 South Woodmont Ave, Cincinnati OH 45213, USA.



TRANS-ATLANTIC AFRICAN ORGANOLGY: THE TRADITION OF RENEWAL

Richard Graham

In my last article in *E.M.I.*, I explored the subject of an African complex of chordophones in a global context, arguing that these instruments are equally experimental as they are traditional. With a little reflection it seems that such a dichotomous definition requires some further explanation. To amplify these ideas it is necessary to undertake a more comprehensive, empirical study of organological change in both Africa and the diaspora. Indeed, the entire process of creolization in the New World should be reassessed and compared to the cultural tides of mother Africa herself, a continent whose social institutions have been evolving continuously. Clearly the organological innovations of creolization owe a great debt to instrument building traditions in Africa, which are also experimental in nature. Within the social framework of African cultures is an open context for individual spontaneity and improvisation, and this is nowhere more evident than in musical practices.

Describing the internal waxings and wanings of religious movements in Kongo, the anthropologist John Janzen termed this phenomenon, "the tradition of renewal". Regardless of the impetus for this cultural change, Janzen showed how the processing of new information fueled the vitality of the iconostrophic cults he documented. This same terminology is equally applicable to the changing forms of African and transAtlantic organology and performance practices. In describing the manufacture of Kongo power containers (*Minkisi*) Janzen may just as well have been discussing Afro-Brazilian musical bows or Central African lamellophones when he wrote,

Not only do *Minkisi* seem to require inventing from time to time, but they become obsolete and are discarded. Thus they manifest the unsure hold of the invisible upon the material in Kongo thought and belief. The reason for this was not always the intervention of the European" (Janzen 1977:71).

Whereas the kinetic influence of Tsayi and Kongo peoples resounds in such New World expressions as Capoeira Wrestling, Jitterbug and break dancing, so too goes the mediating forces of African organological reinvention. For example, the use of new materials and building methods to recreate instruments from existing designs is exemplified by the use of a fiberglass striker to sound a Berimbau string, the implementation of umbrella spokes as Likimbe keys, or the practice of stretching a broom wire over the wall of a shot gun house to create the Diddley Bow. In each of these cases the cast-off products of Western technological society are recycled to build experimental musical instruments within an African cultural framework. The use of "found objects" in African organology pre-dates Duchamp and the Dadaists of the European avant-garde, perhaps being socially reinforced by such Afro-Atlantic visual traditions as Bottle Trees, environmental installations, and grave yard decorations (Thompson 1988:36).

Just as African sculpture spawned a revolution in the Western art world through the African-influenced works of Derain and Picasso, a large number of composers and

musicians are increasingly turning to this magic continent for inspiration. The great vitality of the evolving traditions represented by African organology and performance practices has captured the imaginations of such major figures as Ornette Coleman, John Cage, Jimi Hendrix, and Steve Reich. A closer examination of their sources yields the following revelation: despite the multi-culturalist leanings and cosmopolitan attitudes of these giants, the experimentalist core of their collective works is fully within the tradition of renewal in African music.

As Kubik explained in 1986, creativity in African music is usually an individual operation, and not a collective undertaking as purveyors of the conception of folk music would have us believe (Kubik 1986:57). Within the tradition of renewal the individual innovator provides the spiritual impetus from which the collective may respond and collaborate. The dynamics of this relationship are lucidly described by Chernoff in the following passage:

Thus the individual musician demonstrates his personality precisely by accepting the support and respecting the limitations and potentials of his many relationships to what was before him and what is around him. Then he uses his understanding to bring a living togetherness to the separate elements of an occasion, to provide the music which is Africa's most celebrated means of recreation (Chernoff 1979:126).

Like the broken, rhythmic patterns inherent in Mande textiles, pygmy bark drawings, and their African-American patch quilt progenies, the cultural threads of transAtlantic organology very often seem disjunct. Explaining this phenomenon, Gerhard Kubik imparts, "In brief, a trait sometimes disappears from the surface of a specific culture for a certain historical period, for fifty or a hundred years, including all verbal (oral) references to it. After some time, however, when circumstances are favorable and a need arises (for instance, as a result of incisive social changes, or a war situation) the lost trait is "reinvented" (Kubik 1979:49). These same tempestuous social currents dictate change not only in the trendy world of Hip Hop culture, but flow also along the mighty Zaire river, as Alan P. Merriam discovered. Here his Basongye informants described the disappearance of traditional instruments in their village as casually as a club kid would the demise of the Lambada: "oh well, it was something that passed", and, "it was something that came and went" (Merriam 1977:814). Merriam's survey of this same village over a thirteen year period also noted the arrival of seven new instruments, only one of which was European-derived.

Performance practices as well as organology are in a constant state of flux in sub-Saharan Africa, as evidenced by the following comments of the Dagomba master drummer, Ibrahim Abdulai:

Alhaji was beating the dondon and I was beating the gongon, just as my son Alhassan is following me now. But Alhaji has now given it over to me. At present if we are drumming and

he comes there, he says that we have changed the beat so much that we have spoiled it. And whatever happens, in the future it will also change. Even in our time it is not the original beat. That is what will keep on happening (Chernoff 1979:65).

Diffusion is another important social factor in the African tradition of renewal, with new instruments and ideas travelling great distances over trade routes. Describing the spread of prestige art objects along these routes, Jan Vansina wrote,

Foreign objects, such as a 1785 ship's bell in the nineteenth-century treasure of a Gabonese king, or European crowns in the hands of big men on the Gabon River, and the monarch of the Ogowe Delta, are as typical as the use of a Benin mask by the nineteenth-century ruler of the Igala on the lower Niger (Vansina 1984:161).

The acceptance of objects and new cultural information from both Europeans and other African ethnic groups helps explain the widespread distribution of such singular musical instruments as the double bell and the harp in divergent African communities. Continuous in African music cultures since at least 2686 B.C., the harp appears in more than fifty different cultures there. With this diffusion came sweeping organological changes, for according to DeVale:

The variations in the construction and decoration of African harps serve as excellent examples of the ingenuity of African instrument-makers in creatively utilizing locally available, indigenous materials. African harp-makers incorporate formal design elements that make each instrument a unique expression of a particular culture and performance practice" (DeVale 1989:53).

For the most part, these examples represent internally stimulated cultural change, the older instruments and playing techniques finding little consideration in the aesthetic of African youths, who have ideas of their own. As long as an instrument or style can accept new social information its continuity is insured, each successive generation of musicians renewing the "tradition" through their own innovations. Should an instrument or social context fail to accommodate creativity on the individual level, it will soon lose popularity on the collective level, passing on to make way for newer, more relevant things.

With social institutions in a state of flux in "traditional" African societies, the effects of externally stimulated cultural change can at times be meteoric. In many cases with the availability of the European guitar and under the strong influence of foreign sounds broadcast by local radio, indigenous instruments and songs have completely given way to syncretic, "neo-traditional" music. Throughout Central Africa the lamellophone [African thumb piano] is rapidly losing ground to the guitar, just as it did in 19th century Afro-Brazilian culture. But like the soft, stuttering samba guitar style that emerged in Brazil, the majority of Central African guitar styles are also closely related to performance practices associated with the lamellophone. Consider the following statement by Schmidt-Wrenger,

The Western guitar more and more replaces the issanji [lamellophone]. Nevertheless, the sound of the guitar orchestra

resembles remarkably that of the traditional issanji group. Perhaps this explains why the transition has been so painless — though even Western harmony has to some extent intruded on instrumental music of the Bena Luluwa" (Schmidt-Wrenger 1978:1).

In this extreme case, the context survived although the original orchestration didn't, social demand for experimentation and innovation being far more important than any individual instrument.

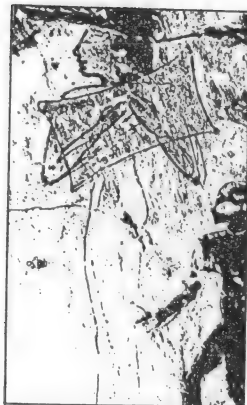
Externally-stimulated change needn't always be so destructive to indigenous organology; in fact it can even feed the tradition of renewal as Kubik brilliantly illustrated:

Ndonga in Usangu represents an interesting case of a neo-traditional kind of music played entirely with so called traditional instruments. It is a music for young people. On the traditional bow with a gourd resonator (the Ndonga musical bow) the player obviously imitates the sounds of an electric bass guitar such as he had heard on records played on Radio Dar-es-Salaam (Kubik 1978:103).

It is also quite interesting to note that most popular electric bass styles still owe a remarkable debt to the transAtlantic influence of yet another African monochord, the Ground Harp. The percussive time-line patterns associated with popular bass styles find their geneses in the transmission of these African musical values from such instruments as the Zairois *nkuti kabidi* to the New World washtub bass, and finally to the upright and electric bass styles of African-Americans. So the density of such musical echolalia as represented by the acculturated Tanzanian *ndonga* styles really needs to be appreciated as part of a long tradition of experimental music, and not as "mutation" of local expressions.

Yet despite the mounting examples of archaeological, iconographical, oral and literary evidence, most Westerners continue to subscribe to popular 19th century myths of the backward, "Dark" continent. This misunderstanding of changing Africa has also undermined perceptions of her cultural institutions. With the exploitation and enslavement of her citizens, the African musical genius came to the New World where despite seemingly insurmountable social pressures, it flourished into a diamond-like radiance, lighting up the social landscape with its glowing brilliance. Centuries later, its appreciation begins in academic and popular circles.

In the diaspora, the tradition of renewal continued at full steam as the slaves were constantly exposed to new stimuli; European music and instruments, new building materials and methods, and new social contexts for existing African instruments. From the very beginning, African musical instruments were a strong social force in slave life, being present in many cases on ships making the middle passage. Of this custom, Epstein concluded, "it seems beyond doubt that slave captains for purely pragmatic reasons were unwitting agents in transmitting African instruments to the New World" (Epstein 1977:14). The unfortunate context of this ship-board music making was to exercise the slave's limbs by "dancing" them to prevent atrophy, the motives being strictly monetary. Regardless of the cruel tragedy of their forced migration, the improvisational genius of the Africans remained intact. On one 19th century slave ship this creative impulse produced an experimental drum substitute which foreshadowed or-



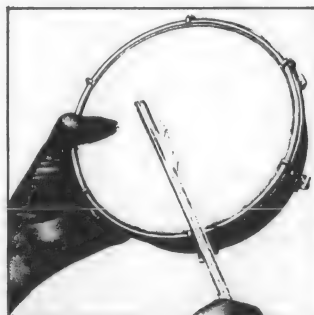
HISTORICAL DEVELOPMENT OF THE TAMBORIM

Left: Rectangular Frame Drum, Egypt 1400 BC.
Center: Adufe Spain 1565 AD (artist unknown)
Right Above: Stick Beaten Adufe, Brazil 1840 AD, by Ligia Da Cunha
Right: Tamborim, contemporary.

of extant tomb murals. Apparently, Africans were as trendy then as they are today, for according to Hickmann, "We must believe that it is a matter of the rectangular tambourine having been a 'fashionable' instrument which, as always in similar cases, was of a foreign import and which disappeared without leaving any traces" (Hickmann: 1951:321). Of course the rectangular drum didn't disappear but merely diffused to more receptive cultures in North Africa, where even further organological changes occurred. In Morocco it continued its long association with Women's music and rituals, the addition of a number of gut snares shading the drum's timbre with a gentle, buzzing sound. The sociological reasons responsible for this change are, unfortunately, lost in the desert sands of long ago. We do know that the instrument became known as *al daff* or *al duff*, probably after the Sumerian term for a grain measure which was similarly shaped, the *a-da-pa* (Galpin 1937:9).

After the Moorish invasion of Southern Spain and the establishment of an Islamic kingdom by the Caliphate of Cordoba in 755, the *al duff* diffused throughout Southern Europe, where it is today known by its Hispanic gloss, *Adufe*. Along with African instruments came yet another African innovator, an ex-slave named Ziryab whose influence at the court of Cordoba was enormous. Credited not only with transforming domestic manners and organology, this African genius created the first music conservatory in Cordoba, introducing there ancient Graeco-Persian songs which became, "the veritable melodic matrix of earlier European music" (Amo 1977:6). Much in the spirit of this master musician, who claimed inspiration from nocturnal visits by *jinn* (sprites), creative forces in Spain and Portugal continued to transform the Adufe. Here the addition of small pellet bells inside the corpus of the instrument created a metallic jingle to supplement the dry timbre of the instrument's laced drum skins.

With the Portuguese establishment of colonies in 16th century Brazil, many aspects of Lusitanian material culture came to the New World, the adufe amongst these. Next came the forced migration of millions of African captives during the Atlantic slave trade, peoples



from the Kongo/Angolan area being paramount in importance. Along with a myriad of musical practices, slaves from this area brought to Brazil the phenomenon of the *kachacha* time line pattern, a sixteen pulse rhythmic unit played repeatedly to orient dancers and musicians in the rich, polyrhythmic mesh (Kubik 1979:16,17). Rendered as x.x.x.xx.x.x.xx on a hard sonorous object, the *kachacha* time line is the backbone of Brazilian samba and related musical forms. Today the production of this vital element of African music is relegated to the tamborim player(s) in the *escola de samba*, as well as in the *congada*, *bossa nova* and other musical ensembles.

Of the many religious folkloric cycles exported to Brazil by the Portuguese, the *danca de Santa Cruz* is one of the more vital institutions. The annual appearance of the adufe in the instrumental accompaniment of this Iberian tradition may have sparked the minds of the slaves who adopted it for their own purposes. By the early 19th century, the Brazilian painter Lygia de Cunha documented the employment of the adufe by slaves in her paintings of the *Congada*, a social institution that maintained traditions associated with Kongo royalty. Included in

these ensembles is the rail marimba, an instrument synonymous with Central African kings, as well as other African and European instruments.

In her two illustrations of the adufe, de Cunha clearly depicts them as beaten with a single stick, a radical departure from the delicate finger strokes which sufficed to sound the instrument since the time of Hatsheput and Tutmosis III. Headed with snake skin, these instruments appeared to be mono-membranous, an organological change which facilitated the tapping of unaccented strokes played by the fingers of the supporting hand against the inside of the drum skin. In the transcription above these strokes are represented by the ., the stick beats by the x. With the re-Africanization of this ancient framedrum by a sub-Saharan ethnic group comes a unique spin on the tradition of renewal. Still, the metamorphosis of the tamborim was far from complete, the social pressures of its new musical context dictating even further change to insure longevity.

One of the most dramatic changes was the elimination of the sound-altering accoutrements such as the pellet bells and snares. By 1938, photos taken in Belem reveal that the tamborim, like its predecessors, continued to shrink in size. Ironically, the drum once again appears in a rectangular form, another departure from the square forms which many of the Portuguese models had assumed (Alvarenga 1947:41,53). Clearly the Afro-Brazilians needed a high pitched, shrill sound to pierce the cacophony of percussion instruments that constituted much of their orchestration, and with the necessary organological changes, the tamborim, *nee* adufe, fitted this bill. This form continued to be in vogue in Sao Paulo until at least 1960, when de Lima photographed it there in a number of musical ensembles (1981:168). Although this form continued to appear sporadically, little time elapsed before it was once again swept up in the tradition of renewal. In an instruction manual for Brazilian rhythms and percussion instruments, the rectangular tamborim resurfaces again, perhaps for its swan song. Here the composer Laurindo Almeida includes a drawing of it as well as two photos, even transcribing the kachacha time line pattern, a rhythm which he describes as "the most common one". (Almeida 1972:12,13).

Just as in the U.S., Brazil in the 1960's underwent a social revolution which had far-reaching consequences in popular cultural expressions. For the former, the civil rights and anti-war movements were a rallying point, in Brazil, the military dictatorship of 1964 provided similar social stimuli. Resulting musical change in Brazil was not exclusively restricted to the middle class bossa nova, the Afrocentric revival in Bahia, or the avant-garde leanings of the tropicalismo movement, but affected also such stalwart "traditional" institutions as the *escolas de samba* which were equally caught up in the whirl wind of those times. Experimentation became the order of the day.

By this point the tamborim appeared almost ubiquitously as a round frame drum of five to seven inches, the skin being affixed to the head through a threaded tension rod system that rendered the instrument tunable. Along with the disappearance of the tacked-on animal skin heads came the advent of the mylar artificial drum heads. Combined with the tuning capabilities, sambistas were able to torque up the tamborim's pitch to incredible highs impervious to the debilitating effects of Brazil's humidity, which had devastating effects on natural heads. Even here the restless spirit of African ingenuity continued without faltering, for by the mid-sixties tamborimistas began to experiment with multiple beaters to achieve a loud

"flam" effect (Gardel 1967:151). Among other developments of the sixties and seventies was the use of a flexible plastic switch to "whip" the drum head, facilitating a technique wherein "Double strokes and ornamental triplets are achieved by turning the tamborim with the left hand so that the drum skin catches the switch as it rebounds from the previous stroke" (Graham 1989:14). At this time various new materials were introduced to form the drum shell, including lucite, brushed aluminum, and stainless steel.

The metaphorical meanings of transAtlantic organological changes as exemplified by the steel drum and tamborim are indicative of African cultures as a whole. Experimentation within African social frameworks insured the longevity of the host cultural institutions, for we are dealing here with an active living culture made up of individuals whose solitary activities breathe life into that of the collective. Still the persistence of Eurocentricism prevails, as Thompson complained:

If Americans think of Africa as a classical antecedent at all, they do so frequently in terms of the latter's subordination or irrelevance. They assume "tribal" Africa was somehow committed to stasis whereas Europe was committed to novelty" (Thompson 1987:17).

Myriad musical examples defeat this narrow viewpoint, as a balanced reading of the ethnographic literature so richly reveals. Among the many examples consider the *vaccine*, a Haitian aerophone of Central African extraction. This African trumpet received its French appellation from a cultural association with the medicinal cupping horn used by the Houngans, Vodun priests and herbologists. Like many aspects of Haitian folkways, the *vaccine* originated in Zaire, where a variety of similar aerophones are found. Like its African precursors, the *vaccine* is hewn from a bamboo stalk, the length and width of which determines the instrument's pitch. Today the instrument appears in a number of forms including those consisting of recycled metal pipes and pvc tubes, all of which are aspects of the Kongo found object paradigm. An interesting convergence is the pan-American appearance of sheet metal *vaccines*, forms found not only in Port-au-Prince but in New Orleans as well. Perhaps most noteworthy amongst Crescent City performers is Noone Johnson, whose "bazooka" *vaccine* powered many a Jazz funeral, calling down the ancestors like a BaKongo Gabriel.

Writing on the sculptural qualities inherent in many of Africa's most beautiful musical instruments, Brincard also illustrated their diversity: "The range and richness of these styles will be self-evident if one compares the extreme reduction or abstraction of the Lua Mbira the geometric essentialism of the Malinke horns, the idealized realism of the Zela drum, the complex sculptural structure of the Baga drums, and the marvelous fluidity of the miniature Vili slit gong" (Brincard 1989:18). Many of the experimental musical instruments of the African diaspora have similar appeal, most notably, the chordophones. The fusion of Senegambian lutes such as the *halam*, *molo*, and *garaya* produced through pan-African technology-sharing one of the New World's most enduring instruments, the Banjo. In 18th century Suriname and 19th century America, representatives of this distinguished family of chordophones preserved the cutting edge of African wood carving within the more ornamental aspects of their construction. Renewing this tradition are two contemporary instrument builders, Lonnie Pitchford of Lexington, Mississippi and Everaldo Brown of Kingston, Jamaica. The

innovative creations of these two Black artists incorporate organological traits of several African prototypes with those of the European guitar.

Turning again to Janzen's discussion of religious changes in Kongo, he imparts to us this passage which is equally applicable to all of these trans-Atlantic organological innovations: "In the dynamic balance between the original model and the reproduction, between the devotee and the iconoclast, we have an interesting matrix in which to study the tradition as processed" (Janzen 1977:72). As the ancestral torch passes from one generation of musicians to the next, the tradition absorbs new information, and the processing which is renewal guarantees its continuity. This does not imply that those individual innovators who traversed the boundaries between tradition and renewal in African music cultures did so without adversity. As one unkind critic once barbed of the instrumental choices of harmelodic pathfinders Ornette Coleman and Don Cherry (respectively a plastic saxophone and a pocket trumpet), "Why they're not even playing real instruments". Considering that the offending axes were European instruments, one can only wonder how their later more African instrumental choices were appraised.

Regardless of such snags in the socio-musical fabric, the tradition of renewal will doubtless continue to radiate throughout African music cultures, absorbing each new influence like the fluctuating patterns of a rhythimized quilt. The cultural occasions for improvisation are seemingly endless in the African sphere of influence, permeating nearly every facet of life, spiritual and material. The resulting mosaic is perhaps best described by the Zairian anthropologist Fu-Kiau Bunseki: "every time there is a break in pattern that is the rebirth of (ancestral) power in you" (quoted in Thompson 1987:21). Equally descriptive of the aesthetic appeal of improvisation is the following observation by the African-American visual artist David Hammons:

I really love to watch the way Black people make things, houses, or magazine stands in Harlem, for instance. Just the way we use carpentry. Nothing fits, but everything works (in Jones 1986:8).

Here the importance of the individual's expression is on an even keel with the functional considerations of architecture, an accommodation usually only afforded in European culture to such luminaries as say, Frank Lloyd Wright. Almost ubiquitously, improvisation provides the fuel for trans-Atlantic African organology. This same pervasive spirit pulls together such disparate musical innovators as Tanzanian multi-instrumentalist Hukwe Zawose, Brazilian percussionist Nana Vasconcelos, and Mississippian Diddley Bow player Glen Faulkner. The common thread which binds these diverse musicians is organological innovation. All three express their creative impulses on experimental instruments based on traditional models, each maintaining a strong individualism within the collective aesthetic of their cultures. More importantly, these musicians maintain the tradition of renewal in their respective communities, ensuring successive generations a cultural context for experimentation.

Like the *minkisi* power containers of Kongo religions, the inventions and reinventions of trans-Atlantic African music cultures will continue to pull together and aid the members of society through their constructive forces. As each new social need arises, the tradition of renewal in African cultures will continue to produce relevant solutions in the popular cultural

expressions. Turning once again to Janzen, he illuminates this process in a manner most poignant:

Religious renewal in Kongo is not then limited to a particular form, but broadly exists in finding the right alternative form to redeem the situation. This dialectic is the only constant underlying the perplexing wealth of Kongo ritual diversity... (Janzen 1977:112).

Perhaps addressing the most salient attributes of music and power containers is this important observation by U.S. bluesman John Lee Hooker, who sings that "the blues is a healer", stressing the spiritual motivation which is responsible for the material manifestation of African experimental organology. In this sense, musical instruments may function as *minkisi*, providing sources for spiritual renaissance and creative expression through the innovative process of their construction. As organs of continuing ancestral mediation, both *minkisi* and musical instruments are material metaphors for the vitality of their influence, successive changes and reinterpretations being the cultural fingerprints of ensuing generations. In the future, as the tradition of renewal continues to inform further organological developments, we can only hope that the creative process will continue to be enhanced by these social forces, and as the traditional/experimental dichotomy unravels through a greater understanding of this process, that scholarly pursuits will document each exciting new phase of innovative trans-Atlantic African organology.

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The Pope was flying into New York to deliver an important speech at the UN. His plane was late; so late that his limousine driver became impatient and left without him. The Pope found himself flagging a taxi, madly rushing to get to the in time. But did the taxi driver go fast enough to satisfy the Pope? No. "Can't you go any faster?" the Pope kept demanding, "Can't you go any faster?" Finally, in exasperation, the Pope said "Look, let me drive." So the taxi man got in the back seat, and the Pope took the wheel. After a few blocks at hair-raising speed, a NYC policeman pulled them over. When he saw who it was, the cop radioed back to headquarters: "You won't believe this. I've got some body really big." "Who?" headquarters radioed back. "The mayor?" "Nope," says the cop, "Bigger." "The governor?" "Nope, bigger." "Who, then? Not the president?" "Nope, bigger." "Well, dammit, WHO?" "I don't know," says the policeman, "but he's got the Pope for a driver."

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EMI's new prices are now in effect. SUBSCRIPTIONS: \$24/yr for U.S.; \$27/yr for Canada & Mexico; \$34/yr overseas. California residents add 7.25% sales tax for a total of \$26.81. Special note to subscribers in Canada and Mexico: with regret, we have added postage costs to your subscription price for the first time; this is simply a reflection of the higher cost of mailing outside the U.S. and it is more equitable to all subscribers. Order from EMI, Box 784, Nicasio, CA 94946, USA.

EMI BACK ISSUES: Bound volume sets Vol I through Vol V: \$17 per volume. Single issues Vol VI #1 through Vol VII #6: still \$3.50 per issue. Single issues Vol VII #1 and later: \$6.50 per issue. These prices include postage for U.S., Canada & Mexico air, and overseas surface rate. For overseas air add 20%. Order from EMI, PO Box 784, Nicasio, CA 94946, or write for complete listing of back issues and their contents. Corresponding cassette tapes also available for each volume; see information below.

CASSETTE TAPES FROM EMI: \$8 per cassette for subscribers; \$10.50 for non-subscribers. Prices include postage for U.S., Canada, Mexico air, and overseas surface rate. For overseas air add 20%. Each tape contains music of instruments that appeared in the newsletter during the corresponding volume year, comprising a full measure of odd, provocative, funny and beautiful music. Our supplies of Volumes I and IV are nearing exhaustion and guess what? We ain't gonna press more of them when they're gone. Order from EMI, Box 784, Nicasio, CA 94946.

RECORDINGS REVIEWS

by Mike Hovancsek

VARIOUS ARTISTS:

ReR RECORDS QUARTERLY MAGAZINE VOL.2 #3&4 AND VOL.3 #1&2Records and magazines from 19-23 Saint Saviour's Road,
London SW2 5HP UK.

Chris Cutler, a respectable musician in his own right, continues to assemble some of the best compilation record/magazine packages available. Each quarterly comes with a magazine that is packed with informative articles about music in addition to descriptions of the pieces featured on the recorded portion of the package. Each record is comprised of music from some of the more adventurous musicians recording and performing today, ranging from rock bands seeking to stretch beyond the standard parameters of the format to people who work with home-made instruments.

Vol. 2 #3 includes a taste of John Oswald's Plunderphonics (music created from the manipulation of other people's recordings), Dave Meyer's feedback music, and an amazing, frantic piece by When for keyboards, guitar, percussion, drumtrunk, xylophone, tapes, and prepared toys.

Vol. 2 #4 includes Werner Kodytek's embellished environmental collage, Lutz Glandien's systematically structured samples, and a phenomenal piece by Thinking Plague which features some great rock music accompanied by processed junk percussion.

Vol. 3 #1 includes a piece by a group called Overflow in which sounds are primarily derived from blown and struck polypropylene tubing, Don Wherry's work with ship horns, bells, and alpenhorn, and a piece by Trevor Wishart for voice controlled electronics.

Vol. 3 #2 Includes another piece by Dave Myers (this time in collaboration with Alex Ross), Zygmunt Krauze's work with stones placed on strings, and Pierre Bastien's music for exotic instruments which are modified to be played by mechanical processes.

All of the **ReR Quarterly** are quality packages that generate interest in some truly innovative approaches to music.

INTERVAL: **INTERVAL SAMPLER VOL. 1**On cassette from the Interval Foundation P.O. Box 620027
San Diego, CA 92102.

This ensemble is an extension of the Interval Foundation which is dedicated to promoting and exploring microtonality through various routes including the publication of **Interval Magazine** (appearing in the late 70's and early 80's), the Sonic Arts Gallery in San Diego, and the distribution of recorded works.

The instruments appearing on "Interval Sampler Vol. 1" include flute, tablas, bass guitar, and shaker, in addition to instruments that were designed specifically for microtonal applications like 19-tone acoustic guitar, 19-tone electric guitar, array mbira, and 17-tone synthesizer.

The music on this tape ranges from electronic pieces to world music inspired jazz. Interesting tunings and well executed performances abound here as the four performers wander into some of the outer reaches of microtonality.

Unfortunately, the liner notes fail to yield sufficient information on the tunings and the unconventional instruments used in this recording. For a group of people who are committed to promoting new tunings it is strange that they don't do more in this department.

It is also a bit disappointing that this group lapses into a Windham Hill - style new age mode from time to time. Where new age music is often unengaging (intentionally so), experiments in tonality tend to require more attention from the listener in order to be fully appreciated. Consequently, the darker, moodier pieces on this tape are easily the most effective and worthwhile that Interval has to offer.

VARIOUS ARTISTS: **MUSICWORKS 48, 49 AND 50**Magazine and cassette from **Musicworks**, 1987 Queen Street West,
Toronto, Ontario M6J1H3 Canada.

Musicworks is a Canadian journal of sound exploration that combines informative articles on music with cassette compilations that allow **Musicworks** readers to hear the work of the composers/musicians featured in each issue. Many of the people who appear in the compilations work with self-designed instruments, some utilizing innovative compositional approaches and unusual tunings.

Musicworks 48 includes a piece by Don Wherry for ship horns that (because of the long distance between the ships) sounds different depending on the listener's location in the city, a duet between Susan Rawcliffe and Gayle Young for didjeridu and a self-designed bowed instrument, and pieces by Warren Burt for mathematically derived music.

Musicworks 49 includes a collage of unique instruments from the "Sounds of Invention" exhibition, a piece by Charlie Morrow including spun instruments and conch shells, and Nicolas Collins' infamous "trombone propeller".

Musicworks 50 includes the incredible Robert Minden Ensemble which plays vacuum cleaner hoses like swung dijeridoos, cardboard tube drums, plastic tubing, spoons, musical saw, waterphones, and conventional instruments. Michael Burtch's waterfront sound sculpture and Trevor Wishart's works for extended vocal pieces are also featured.

Overall, **Musicworks** is a responsible, high quality package that informs and entertains while it gives exposure to numerous innovators in the field of sound exploration.

It is refreshing to see a publication that is able to feature so many substantial artists without being overtaken with the pretentious need to be "fashionable".

CLARA ROCKMORE: **THE ART OF THE THEREMIN**Available on CD from Delos International, Inc. 2210 Wilshire Blvd.,
suite 664, Santa Monica, CA 90403.

Few can deny the contribution that Leon Theremin made to electronic music when he first demonstrated his instrument at a convention of engineers and physicists in 1920. From the beginning it was evident that this Russian inventor was years ahead of his time coaxing timbres similar to those of voices and violins from his electronic source.

This particular recording (engineered by electronic music pioneer, Bob Moog) is comprised of twelve short compositions by major composers including Tchaikovsky, Saint-Saens, and Rachmaninoff performed on theremin and piano.

Although the historical significance of the theremin cannot be denied, one has to wonder how long we can marvel over the long outdated sounds that this instrument produces. Not only has electronic music progressed light years beyond the limited timbres of the theremin, its constant presence in tacky 1950s era science fiction movies has turned it into the Elvis of the instrument world.

The selection of material for this recording (sappy, maudlin melodies) does not do much to improve upon its image either. These pieces sound like spacy elevator music versions of the classics. Perhaps a more suitable title for "The Art Of The Theremin" would be "Zamfir Vs. The Martians."

Of course the Theremin is an oddity in the music world and it is admirable that attempts are being made to document its existence on CD. There are however, a couple of places where the theremin appears in a more suitable format. Captain Beefheart, for example, explored many of the bizarre, quirky elements of this instrument on a piece called "Electricity" from his "Safe As Milk" album (available on CD from Repertoire Records). If you can't locate the Beefheart CD there are always science fiction movies from the 1950s.

PETIT MAL ENSEMBLE: WORLD SEIZURE

On cassette from Gatmo Productions P.O. Box 2321, Sebastapol, CA. 95473.

This tape is a series of light, upbeat ensemble pieces with a free spirited, earthy feel. The instruments include springs guiro, rainstick, saw, waterphones, bird calls, spring bowl, and conch shell in addition to numerous more conventional instruments like guitars, synthesizers, and lap steel.

To quote the liner notes, "Our music with elements of jazz, blue grass, rock and new music". Listening to this tape I am often reminded of the early recordings of Oregon and Paul Winter.

Like Oregon and Paul Winter this ensemble is made up of some adventurous and talented musicians who work well together on music that falls somewhere between brilliant musical interactions and new age lightness.

Those who consider new age music to be lightweight fluff will have to wade through approximately one half of the material on "World Seizure" in order to hear the more substantial pieces. Once these substantial pieces are located, however, the listener will find some very personable, interesting ensemble works that are as enjoyable as they are eclectic.

JOHANNES BERGMARK AND HAL RAMMEL: WHERE SAWS SING AND FIDDLES BLOOM

On cassette from Cloud Eight Audio 1622, W. Sherwin, Suite 25, Chicago, IL. 60626, or Surrealistforlaget Roslagsgatan 32, 4tr s-113 55, Stockholm Sweden).

Hal Rammel is an instrument designer and builder who has graced the pages of EMI in the past as both a writer and an illustrator. on "Where Saws Sing" he teams up with Johannes Bergmark to coax sounds out of bowed and struck saws, percussion instruments, slide whistles, and various self-designed instruments. Judging from the title of this tape, it's reliance on saws and fiddles, and its folkish cover art, I expected this music to remain within the parameters of American folk traditions. To my surprise, however, Hal and Johannes used these instruments to unleash a remarkably unsettling assault on their listeners.

At its worst this tape sounds like two hyperactive people frantically rubbing pieces of styrofoam together. At its best it

sounds alternately like whale songs played at double speed or a fiddle interpretation of a John Zorn improvisation.

Of particular interest are the instruments that were designed and built by Hal Rammel. The triolin (featured in EMI Vol. 3 #4) is a triangular acoustic chamber which has metal rods protruding in a circular arrangement out of the broad side of its body. Sounds are produced when the triolin is spun by a handle secured on the back of the instrument while the performer applies a bow to the rods.

Other instruments include aerolin (a stringed version of the triolin), bamboo fiddle (a bamboo tube that has strings running the length of its body) and gopichand ("bowed and plucked monochord of the Bauls of Bengal").

It would be interesting to hear what melodic and rhythmic potential lies in Hal's instruments but he chooses instead to concentrate of free jazz-like improvisations with Johannes Bergmark.

Since these improvisations were recorded without the aid of overdubbing or other recording enhancements, the bulk of "Where Saws Sing" sounds rather stark. Had these guys laid their arhythmic, non-melodic improvisations over a tight web of subtle percussion or extended pitches emanating from some of the bowed instruments, this tape would have been a little more effective. In fact the best pieces on this tape include sparse percussion accents that fill out the lower end of the pitch range where it remains otherwise untouched by the high pitched instruments featured on "Where Saws Sing".

Hopefully, Hal will continue to record the instruments he has designed and built. As interesting as "Where Saws Sing" is, it seems to explore a mere portion of what his brilliantly designed instruments are capable of producing.

QUBAIS REED GHAZALA: BURNING SUNS OF SHADOW WORLDS

On cassette from Ladd-Frith, P.O. Box 967 Eureka, CA. 95502.

Simply stated, Q.R. Ghazala is a genius. Featured in the April/May '92 issue EMI, Ghazala has designed and built numerous innovative instruments and modified many others. His instruments range from xylophones made from animal bones to instruments that sample, modify, and reinterpret the sound that happen around them. "Burning Suns" is Ghazala's most recent in a long list of releases featuring his unique instruments. The seven pieces on this tape are beautifully recorded performances utilizing an incredible collection of sound sources including er-hu (Chinese fiddle), short-wave radio, fish bowl, bicycle, custom made electronic devices, tape manipulation, animal/nature sounds, mechanical sounds, digestion sounds, and many more. Judging by this odd collection of sound sources it is easy to assume that the resulting product is a chaotic barrage of meaningless noise. Amazingly, this is not the case; Ghazala manages to produce a very slick collection of pieces which range from collages to one man ensemble pieces.

It is also remarkable that Ghazala is able to produce such an emotionally charged, mature work considering that he employs bicycles, digestion sounds, and other bizarre instruments in the execution of his pieces. Surprisingly, he sounds more like a non-spacy version of Isao Tomita than a modern day Spike Jones.

My only complaint about "Burning Suns" is that it doesn't include more extensive liner notes. It would be nice if Ghazala would go into more detail in describing his self-designed instruments rather than simply listing them as "custom electronic devices". After All, many of the instruments he has

designed and built are among the most interesting and unusual a person could hope to encounter.

Articles featuring some of Ghazala's fascinating instruments have appeared in EMI Volume VII #5 and in the current issue.

AKIO SUZUKI: **SOUNDSPHERE**

Available on CD from Het Apollohuis Tongelrestraat 81 5613 DB Eindhoven, The Netherlands.

"Soundsphere" is a beautiful package which includes a CD and a booklet of information on Akio Suzuki. Akio works with two self-designed instruments in this recording: an echo instrument called Analapos and a "Suzuki Type Glass-Harmonica".

Analapos is a spring which has a cylinder attached to either end (much like a toy telephone made with two cups and a piece of string). This instrument can be plucked or it can be played by making voice sounds into one of the cylinders.

The "Suzuki Type Glass Harmonica" is a series of glass tubes of varying diameters which are suspended horizontally. Akio plays this instrument by striking the tubes with a stick and by rubbing his moist fingers against them.

The accompanying booklet details numerous Akio Suzuki compositions (none of which appear on the CD). An example of one of the compositions is as follows:

1. 24 plates are piled up on a circumference point, and are moved to the center point one by one from the top of the stack.
2. I pick up the plates at the center and slide them clockwise.
3. I pick up the plate at the starting point and place it on the next plate clockwise. In this way, all the plates are piled up again and I carry 24 plates back to the starting point.
4. A plate is moved to the center once again. Spontaneously I picked up the plates one by one and dropped them onto the one at the center. As I caught the last plate before it reached the floor, the performance ended.

Another composition involves walking in circles while ripping up newspapers and still another involves playing several records at one time. Needless to say, Akio's compositions are not for everyone. His work tends to be too conceptual for the average listener and too unoriginal for conceptual music aficionados. There is nothing in this booklet, after all, that hasn't already been done by John Cage or others like him.

This inaccessibility is also reflected in the recorded portion of the "Soundsphere" package as Akio relies too heavily on too few timbres. The Analapos pieces consist entirely of the fluttering sounds of the plucked spring while the "glass harmonica" pieces consist entirely of the sound of the glass tubes being struck with an unvarying rhythm.

Had Akio Suzuki composed these pieces in the 1940s he would have seemed very avant-garde but there is no reason to present these ideas as original or new in the 1990s.

ROTODOTI: **TARZAN SPEAKS**

On CD from Artifact Recordings, 1374 Francisco Street, Berkeley, CA 94702.

Rotodoti is an ensemble dedicated to spontaneous musical interactions that extend well beyond the parameters of traditional improvisation. Working without a score or prearranged themes, these four musicians concentrate on extended playing

techniques and unique instrumentation.

EMI readers are already familiar with Tom Nunn (EMI Vol. 1 #3 & #4, Vol. 2 #3, and Vol. 6 #1) who plays various self-designed instruments on this recording including electronically amplified and processed inventions built from wood, sheet metal, strings, combs, sandpaper, and metal rods. Tom is in good company in this ensemble joining forces with Ron Heglin (using extended techniques for voice and trombone), Doug Carroll (playing prepared and electronically altered cello in addition to a MIDI cello interface used to play digital samples), and Tim Perkins (playing "a special synthesizer controller, the mouse guitar, which allows intuitive, physical access to a wide range of synthesizer sounds").

This combination of electronic, acoustic and electroacoustic instruments is particularly successful here creating a sound that incorporates elements of musique concrete and free improvisation used seamlessly, intuitive pieces. Improvisations of this strength could only result from an ensemble that has played together for years.

Equally impressive is the sound quality of "Tarzan Speaks" which was recorded live in various performance spaces and studios in California and the Netherlands. Amazingly, this recording sounds better than many multi-tracked studio recordings by similarly inclined ensembles. Rotodoti is a fascinating source of interaction between four very interesting musical innovators.

TAN DUN: **NINE SONGS**

On CD from Composers Recordings, Inc. 170 West 74th Street, New York, NY. 10023.

"Nine Songs" is an impeccably recorded CD of Tan Dun's ritual opera for vocals, percussion, winds, plucked instruments, contrabassoon, and xun. Among these instruments are the ceramic creations of Ragnar Naess (featured in EMI Vol. 7 #2) who expanded upon traditional instrument designs by utilizing clay as the main building material in place of wood, bamboo, and gourds.

Like the unique instruments used in this recording, Tan's composition is a brilliant combination of ancient and modern elements balancing the primal, ritualistic elements of Oriental music with 20th century minimalist and avant-garde sensibilities. The music of "Nine Songs" falls somewhere between a Tibetan invocation, Korean Pansori music, and a Harry Partch opera (although I hesitate to make the Partch comparison because Tan Dun is obviously more than a mere Partch sound-alike).

The 24 musicians employed in this performance were well chosen for their ability to bring "Nine Songs" to life. Their impassioned performance is a powerful, well coordinated display of talent that perfectly complements Tan's compositional style. This is no small feat considering the complex structural, conceptual, and cultural ideas imbedded in Tan's work.

"Nine Songs" is an impressive recording of an amazing composition and a wonderful vehicle for Naess' ceramic instruments.



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The following is a listing of selected articles relating to musical instruments which have appeared recently in other publication.

"A History of the Just Guitar" by John Schneider, in *1/1* Volume 7 #3, March 1992 (535 Stevenson St., San Francisco CA 94103).

A rundown on approaches to just intonation for the guitar, from Mersenne's observations in 1637 to present day techniques.

"Tracker Organ Building Today: Making 'Old' Organs with Computers" by Herbert L. Huestis, in *Continuo* June 1992 (PO Box 327, Hammondsport, NY 14840).

A ten-page report, with lots of photographs, on what's old and what's new in organ making.

"Harp Guitar: That Extra-String Thing" by Jonathon Peterson, in *American Lutherie* Number 29, Spring 1992 (8222 South Park Ave., Tacoma, WA 98408).

Lots and lots of photographs and descriptions of harp guitars in irresistible, improbable and fanciful shapes. Following Peterson's article are plans for making the Dyer Harp Guitar, drawn and with notes by Todd Brotherton.

"Free Plate Tuning, Part Two: Violins" by Alan Carruth, also in *American Lutherie* Number 29 (address above).

The second installment in Alan Carruth's introduction to plate tuning, the practice of fine-tuning the wood in string instrument soundboards. This section deals with violins; a third on guitars will appear in *American Lutherie* #30.

"Plugs-Perc", in the "News From the Industry" section in *Percussive Notes* Volume 30 #5, June 1992 (701 NW Ferris, Lawton, OK 73507).

A brief news release on a new percussionist's instrument called *Sizzle Strip*, consisting of a single thin strip of flexible metal, about a half inch wide and two feet long, mounted at one end and allowed to flop over sideways. This writer, having fooled around with such an arrangement himself, can vouch that floppy metal strips like this produce a way cool sound.

"Tone Wood for Folk Harps" by Danny Jahr, in *Folk Harp Journal* (4718 Maychelle Dr., Anaheim CA 92807-3040).

A discussion of the physical properties that make for good instrument making wood. The emphasis is on harps but the information is widely applicable.

"Deriving Fret Positions, Part 2 by Sam Rizzetta, in *Dulcimer Player News* Volume 18, #2, April-June 1992 (PO Box 2164, Winchester, VA 22601).

The second half of the author's discussion of fret placement on the Appalachian mountain dulcimer. The first installment focused on 12-tone equal temperament; this part moves on to just and meantone.

Also in *Dulcimer Player News* Vol. 18 #2 is a letter to the editor with information on and photographs of an unusual fretted bowed zither and another fretted zither called a raffeale zither.

"Le Steelband (Suite)" by William Taniféani, in *Percussions* (18 rue Theodore-Rousseau, F-77930 Chailly-en Bierre, France).

Bibliography and discography for steelband. The article is in French, but most of the listings are in English.

Ivor Darreg has come out with his June 1992 *Summery Summery* (available from 3612 Polk Ave., San Diego CA 92104). In it he reports on the past year's networking contacts and other highlights in his work with scale system and musical instrument development.

The Galpin Society Journal, March 1992 (38 Eastfield Rd., Western Park, Leicester LE3 6FE, England) contains articles on early 16th century organ building, early pianos, aging and conservation in soundboards, some 18th century brass instrument makers, early English wind bands, the 19th century German post trumpet, plus several shorter notes and queries and book reviews.

The Soundscape Newsletter #3, June 1992 (Department of Communication, Simon Fraser University, Burnaby, B.C., Canada V5A 1S6) has appeared. This issue if full of networking information for people interested in environmental sound and environmentally-aware sound making. Included is a listing of publications and new recordings in the field.

The new Lark in the Morning **Musical Catalog** (PO Box 1176, Mendocino, CA 95460) lists the incredible array of instruments from around the world offered for sale by Lark in the Morning, with photographs and brief descriptions of each.

Tech-no-Com: The Un-Official Publication of the National Association of Professional Band Instrument Repair Technicians, Inc., Volume 16 #2, March-April 1992, is a "special issue — lampoon, satire, parody, takeoff, travesty. Don't believe everything you read!" — in short, a comic version of their regular *Technicom* newsletter, entirely tongue-in-cheek. Should EMI do something like this some day?

CAS Journal Vol. 2, No.1 (Series II), May 1992 (112 Essex Ave., Montclair, NJ 07042) contains an article by Carleen M. Hutchins on the future of violin research, identifying the most promising avenues of investigation. There are additional articles on wood science, guitar acoustics, measurement of violin air and soundboard resonances, and several more topics.

Balungan Volume V #1, Winter/Spring 1991 (Box A-36, Hanover, NH 03755) has appeared, with articles on Gamelan and related music. This issue features several articles on music of Cambodia and Thailand.

Guide to Acoustic and Roots Music Periodicals Summer 1992 (PO Box 3585, Winchester VA 22601) has been jointly published by the publishers of *Dirty Linen*, *The Mandocruician's Digest*, and *Sing Out!*. It's a listing, with reviews, of over 90 different music publications, mostly in the folk, traditional, ethnic and country fields.

